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Title

Maritime navigation and radiocommunication equipment and systems - Automatic identification systems (AIS) - Part 2: Class A shipborne equipment of the universal automatic identification system (AIS) - Operational and performance requirements, methods of test and required test results

Introductory note

This Standard specifies the minimum operational and performance requirements, methods of testing and required test results conforming to performance standards adopted by the IMO in resolution MSC.74(69) Annex 3 Universal Shipborne Automatic Identification System. This standard incorporates the technical characteristics of Class A shipborne equipment included in Recommendation ITU-R M.1371-1 and takes into account the ITU Radio Regulations where applicable. In addition it takes account of IMO resolution A.694(17) to which IEC 60945 is associated.

ATTENTION	ATTENTION
CDV soumis en parallèle au vote (CEI) et à l'enquête (CENELEC)	**Parallel IEC CDV/CENELEC Enquiry**

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FOREWORD

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International Standard IEC 61993-2 has been prepared by working group 8A, of IEC technical committee 80:

The text of this standard is based on the following documents:

FDIS	Report on voting
XX/XX/FDIS	XX/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

The committee has decided that the contents of this publication will remain unchanged until _____. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

Following the adoption by the International Maritime Organisation (IMO) of Resolution MSC.74(69) Annex 3, Performance Standard for a Universal Shipborne Automatic Identification System, TC80 established Working Group 8A to develop IEC 61993-2. Technical requirements were provided in ITU-R M.1371 "Technical characteristics for a universal shipborne Automatic Identification System (AIS) using TDMA (Self-Organising Time Division Multiple Access) in the VHF maritime mobile band". Carriage requirements for SOLAS ships have been adopted by IMO for entry into force starting on July 1st 2002.

In the course of the work, it was found that ITU R Recommendation M.1371 needed several clarifications. These clarifications were introduced at ITU and are included in M.1371-1. The present Committee Draft for Voting incorporates the requirements of M.1371-1.

It was brought to the attention of WG8A that patents and patents pending pertaining to AIS have been made freely available. TC80 WG8A considers the technical implementation specified by this International Standard to be in full accordance with the requirements of Recommendation ITU-R M.1371-1 and as such to be free from claims of intellectual property rights.

The present Committee Draft for Voting also takes into account the provisional results of the work of IMO on operational requirements for AIS.

This CDV includes as annex B (Informative) all the changes to be brought soon to IEC 61162-1. It is expected that this annex B will be removed when going to DIS as by that time the information will be available in IEC 61162-1 through the PAS process, now started.

The provision of a high-speed network connection IEC 61162-3 is optional. It may become a requirement in a later revision of this standard, when the relevant standard (IEC 61162-3) has been adopted.

The IMO Resolution MSC.74(69) Annex 3, Performance Standard for an Universal Shipborne Automatic Identification System, requires that the AIS has a means of processing data from an electronic position fixing system that provides a resolution of one ten thousandth of a minute of arc and uses the WGS-84 datum. Resolution A.815(19) requires an accuracy of position information better than 10m in confined waters. This does not require but implies that if the ship is not equipped with a DGNSS, the GNSS sensor internal to the AIS should be a DGNSS and should be used as source of position information.

Moreover, Resolution MSC.74(69) Annex 3 does not include any requirement for backup arrangements of the position information. However, a GNSS sensor is included in the AIS equipment as the source of UTC. It is felt by TC80 WG8A that this GNSS sensor also can be used as a backup arrangement for the position information obtained from the ships DGNSS. This would ensure the availability of the AIS system in case of failure of the ship's EPFS.

Therefore, TC80 WG8A strongly recommends that manufacturers of AIS equipment implement such an arrangement in accordance with Table 4 of this International Standard.

MARITIME NAVIGATION AND RADIOCOMMUNICATION EQUIPMENT AND SYSTEMS – Automatic Identification systems (AIS)

Part 2: Class A shipborne equipment of the Universal Automatic Identification system (AIS) - Operational and performance requirements, methods of test and required test results

1 Scope

This International Standard specifies the minimum operational and performance requirements, methods of testing and required test results conforming to performance standards adopted by the IMO in resolution MSC.74(69) Annex 3 Universal Shipborne Automatic Identification System. This standard incorporates the technical characteristics of Class A shipborne equipment included in Recommendation ITU-R M.1371-1 and takes into account the ITU Radio Regulations where applicable. In addition it takes account of IMO resolution A.694(17) to which IEC 60945 is associated.

This International Standard also specifies the minimum requirements both for the means to input and display data and for the interfaces to other equipment suitable to be used as means of input and display data.

Note: All text of this standard, that is identical to that in IMO resolution MSC.74(69) Annex 3 and IMO resolution A.694(17) or to that in ITU-R M.1371-1 is printed in *italics* and the resolution (abbreviated to - A3 or - A694 respectively) or the recommendation (abbreviated to – M.1371) and paragraph numbers are indicated in parentheses i.e. (A3/3.3) or (M.1371/3.3) respectively.

2 Normative References

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60945:1996, *Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results.*

IEC 61108-1:1996, *Maritime navigation and radiocommunication equipment and systems - Global navigation satellite systems (GNSS) - Part 1: Global positioning system (GPS) - Receiver equipment - Performance standards, methods of testing and required test results.*

IEC 61108-2:1998, *Maritime navigation and radiocommunication equipment and systems - Global navigation satellite systems (GNSS) - Part 2: Global navigation satellite system (GLONASS) - Receiver equipment - Performance standards, methods of testing and required test results.*

IEC future publication 61108-4 *Maritime navigation and radiocommunication equipment and systems - Global navigation satellite systems (GNSS) - Part 4: Shipborne DGPS and DGLONASS maritime radio beacon receiver equipment.*

IEC 61162-1:2000, *Maritime navigation and radiocommunication equipment and systems - Digital interfaces - Part 1: Single talker and multiple listeners*.

IEC 61162-2:1998, *Maritime navigation and radiocommunication equipment and systems - Digital interfaces - Part 2: Single talker and multiple listeners, high-speed transmission*.

IEC future publication.61162-3: *Maritime navigation and radiocommunication equipment and systems - Digital interfaces - Part 3: Multiple Talker and multiple listeners. High speed network bus.*

IEC 61993-1:1999, *Maritime navigation and radiocommunication equipment and systems - Part 1: Shipborne automatic transponder system installation using VHF digital selective calling (DSC) techniques - Operational and performance requirements, methods of testing and required test results.*

ISO/IEC 3309: 1993 *Information technology -- Telecommunications and information exchange between systems -- High-level data link control (HDLC) procedures -- Frame structure.*

IMO Resolution A.694(17):1991, *General requirements for shipborne radio equipment forming part of the Global Maritime Distress and Safety System (GMDSS) and for electronic navigational aids.*

IMO Resolution A.815(19):1995, *Worldwide radionavigation system.*

IMO Resolution A.851(20):1997, *General principles for ship reporting systems and ship reporting requirements, including guidelines for reporting incidents involving dangerous goods, harmful substances and/or marine pollutants.*

IMO Resolution MSC.43(64) *Guidelines and Criteria for Ship Reporting Systems.*

IMO Resolution MSC.74(69) *Annex 3 Recommendation on performance standards for AIS*.

ITU-R Recommendation M.489-2 *Technical characteristics of VHF radiotelephone equipment operating in the maritime mobile service in channels spaced by 25 kHz*

ITU-R Recommendation M.825-3:1998, *Characteristics of a transponder system using digital selective calling techniques for use with vessel traffic services and ship-to-ship identification.*

ITU-R Recommendation M.1084-4:2000, *Interim solutions for improved efficiency in the use of the band 156-174 MHz by stations in the maritime mobile service*.

Note: ITU-R M.1371-1 references ITU-R M.1084-3, Annex 3. A Draft Revision of Recommendation ITU-R M.1084-3, consequentially leading to ITU-R M.1084-4, has been approved in parallel to the approval of ITU-R M.1371-1.

ITU-R Recommendation M.1371-1:2000, *Technical characteristics for a universal shipborne automatic identification system using time division multiple access in the VHF maritime mobile band.*

3 Abbreviations

AIS	Universal shipborne Automatic Identification System
BT	Bandwidth Time product
COG	Course over ground
CPU	Central Processing Unit
ECDIS	Electronic chart display and information system
EPFS	Electronic position fixing system
ETA	Estimated Time of Arrival
EUT	Equipment under test
HDG	Heading
HSC	High speed craft
IHO	International Hydrographic Office
IMO	International Maritime Organisation

LR	Long Range
MAC	Medium access control
NUC	Not under command
PI	Presentation Interface
RAIM	Receiver autonomous integrity monitoring
Rx	Receive
SOG	Speed over ground
Tx	Transmit
UTC	Universal Time Co-ordinated
VDL	VHF Data Link
VDM	Serial output message containing VDL information (IEC 61162-1)
VSWR	Voltage Standing Wave Ratio

Note: Abbreviations related to IEC 61162 series are not included in the above list. For their meaning refer to that International Standard.

4 General requirements

Requirements contained in this clause 4 are requirements not taken up in other clauses and which cannot be verified by repeatable methods of measurement. These requirements include the applicable general and operational requirements of IEC 60945, as detailed in clauses 6 (Operational checks), 13 (Maintenance), 14 (Equipment manuals) and 15 (Marking and Identification) of that International Standard.

The manufacturer shall declare compliance with these requirements and shall provide relevant documentation. The declarations, documentation and where necessary, the EUT shall be checked or verified by inspection.

The manufacturer shall also declare the composition of the EUT and the category for durability and resistance to environmental conditions for each unit of the EUT as specified in IEC 60945.

4.1 (A3/1) General

4.1.1 General requirements

4.1.1.1 (A3/1.1) *This* standard *specifies the requirements for the universal AIS.*

4.1.1.2 (A3/1.2) *The AIS* shall *improve the safety of navigation by assisting in the efficient navigation of ships, protection of the environment, and operation of Vessel Traffic Services (VTS), by satisfying the following functional requirements:*

- *in a ship-to-ship mode for collision avoidance;*
- *as a means for littoral States to obtain information about a ship and its cargo; and*
- *as a VTS tool, i.e. ship-to-shore (traffic management).*

4.1.2 Capabilities of the AIS

(A3/1.3) *The AIS* shall *be capable of providing to ships and to competent authorities, information from the ship, automatically and with the required accuracy and frequency, to facilitate accurate tracking. Transmission of the data* shall *be with the minimum involvement of ship's personnel and with a high level of availability.*

4.1.3 Additional requirements

(A3/1.4) *The installation, in addition to meeting the requirements of the Radio Regulations, applicable ITU-R Recommendations and the general requirements as set out in*

resolution A.694 (17), shall *comply with the following performance standards, as contained in the following clauses*.

4.1.4 (M.1371/A2-2.14) Transmitter shutdown procedure

(M.1371 A2/2.14.1) *An automatic transmitter hardware shutdown procedure and indication* shall *be provided in case a transmitter does not discontinue its transmission within 1.0 seconds of the end of its transmission slot*.

4.1.5 Quality assurance

The Administration shall require[1] that the manufacturers have a quality control system [2] audited by a competent authority to ensure continuous compliance with the type approval conditions. Alternatively, the Administration may use final product verification procedures where a competent authority verifies compliance with the type approval certificate before the product is installed on board ships.

4.2 (A3/2) Modes of Operation

4.2.1 General

(A3/2.1) *The system shall be capable of operating in a number of modes:*

4.2.1.1 *an "autonomous and continuous" mode for operation in all areas. This mode shall be capable of being switched to/from one of the following alternate modes by a competent authority;*

Autonomous and continuous operation shall be as described in 3.3.5 of Annex 2 of Recommendation ITU-R M.1371-1;

4.2.1.2 *an "assigned" mode for operation in an area subject to a competent authority responsible for traffic monitoring such that the data transmission interval and/or time slots may be set remotely by that authority;*

Assigned operation shall be as described in 3.3.6 of Annex 2 of Recommendation ITU-R M.1371-1 and in 8.1.3 of Annex 1 of Recommendation ITU-R M.825-3 for DSC compatibility; *and*

4.2.1.3 *a "polling" or controlled mode where the data transfer occurs in response to interrogation from a ship or competent authority.*

Polling operation shall be as described in 3.3.2 of Annex 2 of ITU-R M.1371-1 and in Annex 1 of Recommendation ITU-R M.825-3 - for DSC compatibility.

4.2.2 Criteria for reporting

(A3/6.3) *To protect the unauthorised dissemination of data, the IMO guidelines (Guidelines and Criteria for Ship Reporting Systems* Resolution MSC.43(64*))* shall *be followed.*

4.3 Manuals

In addition to the requirements of IEC 60945 clause 14, the manuals shall include:

- the type of external connector required for connection of the external display as referred to in 7.6.3.2;
- the needed information for correct siting of the antennas; and
- the requirements for external illumination, as appropriate.

_____

[1] see SOLAS 1974 as amended Ch. V 18.5

[2] ISO 9000 series, as applicable, meets this requirement.

4.4 Marking and identification

In addition to the requirements of IEC 60945, clause 15, the markings shall include:

a) details of the power supply from which the equipment is intended to be operated; and if applicable,

b) the date by which batteries need to be replaced.

5 Environmental, power supply, special purpose and safety requirements

The AIS shall be tested for compliance with the environmental, power supply, special purpose and safety requirements of IMO A.694(17) as detailed in IEC 60945. The required tests, for which a repeatable method of measurement has been defined, are given in 11, 12 and 13 of this standard. The declaration of category to IEC 60945 required in 4, shall define the relevant tests to be applied as follows:

- AIS equipment declared for protected installation shall meet the requirements described in Table 3 Column "Protected" of IEC 60945.
- Exposed AIS equipment shall meet the requirements described in Table 3 Column "Exposed" of IEC 60945.
- Portable AIS equipment shall meet the requirements of Table 3 "protected" or "exposed" as appropriate.

6 Performance requirements

6.1 (A3/3) Composition

6.1.1(A3/3.1) *The AIS shall comprise*:

6.1.1.1 *a communication processor, capable of operating over a range of maritime frequencies, with an appropriate channel selecting and switching method, in support of both short (VHF) and long (beyond VHF) range applications.* For long range applications the AIS shall provide a two-way interface which complies with IEC 61162*;*

6.1.1.2 at least one transmitter, two TDMA receivers and one dedicated DSC receiver tuned to channel 70;

6.1.1.3 *a means of processing data from an electronic position-fixing system which provides a resolution of one ten thousandth of a minute of arc and uses the WGS-84 datum.*

An interface (IEC 61162) shall be provided to input the position used for navigation. Position information, if available from other EPFS, shall be used only as a back up and the user shall be informed of this (see 6.10).

6.1.1.4 *a means to automatically input data from other sensors meeting the provisions as specified in paragraph* 6.4.1.2; A means, external to the AIS, to comply with this requirement shall be tested to the applicable requirements of IEC 60945.

6.1.1.6 *a means to input and retrieve data manually.* The possibility of manual input and retrieval as described in 6.11 shall be demonstrated based on the manufacturer's documentation

6.1.1.7 *a means of error checking the transmitted and received data (see 7); and*

6.1.1.8 *built in test equipment* as specified in 6.10.

6.1.2(A3/3.2) *The AIS shall be capable of:*

6.1.2.1 *providing information automatically and continuously to a competent authority and other ships, without involvement of ship's personnel;*

6.1.2.2 *receiving and processing information from other sources, including that from a competent authority and from other ships;*

6.1.2.3 *responding to high priority and safety related calls with a minimum of delay* (refer to Recommendation ITU-R M.1371-1, Annex 2, Chapter 3.3.8.1 and Chapter 4.2.3); and

6.1.2.4 *providing positional and manoeuvring information at a data rate adequate to facilitate accurate tracking by a competent authority and other ships.* (See 6.5.2).

6.2 Internal GNSS Receiver

6.2.1 (M.1371-A1/3.1) UTC source

Since UTC is required for synchronisation purposes, an internal GNSS receiver shall be used to determine the UTC.

6.2.2 Source for AIS position reporting

When the external position is unavailable, the internal GNSS receiver may be used as a source for AIS position reporting.

When the internal GNSS receiver is performing as a source for position reporting,

- an appropriate BIIT indication shall be output on the Presentation Interface (see 6.10.1)
- the position data shall be continuously displayed on the minimum display
- the internal GNSS receiver shall be capable of being differential corrected, at least by evaluation of msg 17.

In this case the internal GNSS receiver shall meet the following requirements of IEC 61108 series: position accuracy, COG / SOG, acquisition, re-acquisition, receiver sensitivity, RF dynamic range, interference susceptibility, position update, failure warnings, status indications and integrity flag.

NOTE: Resolution MSC.74(69) Annex 3 requires the AIS to have a means of processing data from an electronic position fixing system that provides a resolution of one ten thousandth of a minute of arc and uses the WGS-84 datum (see 6.1.1.3).

Considering:

- SOLAS Ch.5 does not require a ship to carry an EPFS fulfilling this specification,
- Resolution MSC.74(69) Annex 3 does not specify details of position sensor,
- Resolution A.815(19) requires an accuracy of position information better than 10m in confined waters,

it is recommended that the manufacturers use a DGNSS receiver as the internal source for the AIS position.

6.3 (A3/4) User interface

To enable a user to access, select and display the information on a separate system, the AIS shall *be provided with an interface conforming to an appropriate international marine interface standard.* All interfacing shall be made via the system interface as described in 7.6 (called presentation interface). Where a suitable IEC 61162 interface standard is available, it shall be used.

If no suitable IEC 61162 interface standard is available, an alternative appropriate interface may be used.

6.4 (A3/5) Identification

For the purpose of ship and message identification, the appropriate Maritime Mobile Service Identity (MMSI) number shall *be used* .

6.5 (A3/6) Information

6.5.1 (A3/6.1) Information provided by the AIS

The information provided by the AIS shall *include:*

6.5.1.1 Static

- *IMO number (where available)*
- *Call sign & name*
- *Length and beam*
- *Type of ship*
- *Location of the* in use *position-fixing antenna on the ship (aft of bow and port or starboard of centreline)*

6.5.1.2 Dynamic

- *Ship's position with accuracy indication and integrity status*
- *Time in UTC* [3]
- *Course over ground* (COG).
- *Speed over ground* (SOG).
- *Heading*.
- *Navigational status (e.g. not under command (NUC), at anchor, etc.- manual input)*
- *Rate of turn (where available)*

6.5.1.3 Voyage related:

- *Ship's draught*
- *Hazardous cargo (type; as required by a competent authority).*
- *Destination and estimated time of arrival (ETA) (at masters discretion)*

6.5.1.4 Short safety-related messages

- *Short safety-related messages*

6.5.2 (A3/6.2; M.1371-A1/4.2.1) Information update rates

The different information types are valid for a different time period and thus need a different update rate.

Static information: *Every 6 min, when data has been amended, and on request.*

Dynamic Information: *Dependent on speed and course alteration according to* Table 1

Voyage related information: *Every 6min, when data has been amended, and on request*

Safety-related message: *As required*

Table 1 Information update rates for autonomous mode

Type of Ship	*Reporting interval*
Ship at anchor or moored and not moving faster than 3 knots	*3 min*
Ship at anchor or moored and moving faster than 3 knots	10 sec
ship 0 – 14 knots	*10 sec*
ship 0 – 14 knots and changing course	3 1/3 sec
ship 14 –23 knots	*6 sec*
ship 14 - 23 knots and changing course	*2 sec*

3 Date to be established by receiving equipment

ship > 23 knots	*2 sec*
ship > 23 knots and changing course	*2 sec*

NOTE: *The reporting rate* shall *increase to once per 2 seconds* in accordance with Recommendation ITU-R M.1371-1, Annex 1, Chapter 4.2.1, Footnote (1), *when the station determines that it is the semaphore.*

6.5.3 (A3/6.2; M.1371-A1/4.5.2) Ship Reporting Capacity

The system shall *be able to handle a minimum of 2000 reports per minute, to adequately provide for all operational scenarios envisioned* and is capable of handling up to 4500 reports per minute on two channels.

6.6 (A3/6.3) Security

A security mechanism shall *be provided to detect disabling of the AIS and to prevent unauthorised alteration of input or transmitted data. To protect the unauthorised dissemination of data, the IMO guidelines (Guidelines for Ship Reporting Systems)* shall *be followed.*

Means shall be provided to automatically record all periods when the AIS installation is non-functioning. It shall not be possible for the user to alter any information recorded by this device.

The last 10 times when the equipment was non-functioning for more than 15 min shall be recorded, in UTC time and duration, in a non-volatile memory. Means shall be provided to recover this data.

6.7 (A3/7) Permissible initialisation period

The installation shall *be operational within 2 min of switching on.*

NOTE: Sensors used with the AIS shall meet the requirements of their individual product standards (for example - IEC 61108-1 for GPS which permits 30 min to operation when there is no valid almanac data available, or IEC 61108-2 for GLONASS).

6.8 (A3/8) Power supply

The AIS and associated sensors shall *be powered from the ship's main source of electrical energy. In addition, it* shall *be possible to operate the AIS and associated sensors from an alternative source of electrical energy.*

6.9 (A3/9) Technical characteristics

The technical characteristics of the AIS such as variable transmitter output power, operating frequencies (dedicated internationally and selected regionally), modulation, and antenna system shall *comply with the appropriate ITU-R Recommendations.*

6.10 Alarms and indications, fall-back arrangements

6.10.1 Built in test equipment

The AIS shall be equipped with built in integrity tests (BIIT). They shall run continuously or in appropriate intervals simultaneously with the standard functions of the equipment.

If any failure or malfunction is detected that will significantly reduce integrity or stop operation of the AIS, an **alarm** is initiated. In this case

- the alarm shall be displayed on the minimum display
- the alarm relay shall be set „active“
- an appropriate alarm message shall be output via the Presentation Interface and repeated every 30 sec.

If a change of a relevant system status as described below is detected, an **indication** is given to the user. In this case,

- the indication shall be accessible on the minimum display
- an appropriate alarm message shall be output via the Presentation Interface.

6.10.1.1 Alarm messages

Alarm messages shall be IEC 61162-2 compliant "$AIALR"-sentences on the presentation interface output port.

The parameters of this sentence formatter

- Time of alarm condition change (UTC),
- local alarm identifier (alarm ID),
- alarm condition flag,
- acknowledge state flag,
- alarms description text

shall be set according to Table 2 and Table 3 below.

The alarm condition flag shall be set to "A" in case of an alarm, "V" in case of an indication.

The acknowledge state flag shall be set after acknowledgement of an alarm internally by means of minimum display and keyboard or externally by a corresponding ACK sentence.

The local alarm identifiers (alarm ID) given in the table below are defined for the use with formatters ALR, ACK, and as text identifiers in TXT sentences to link associated messages.

Additional numbers may be used by the manufacturers for other purposes but shall be in the range 051 – 099.

6.10.1.2 Relay alarm output

A NC (normally closed) earth free relay contact shall be provided as an independent and simple method for triggering an external alarm.

The alarm relay shall be "active" in case of power "off".

The alarm relay shall be deactivated upon acknowledgement of an alarm either internally by means of minimum display and keyboard or externally by a corresponding ACK sentence.

6.10.2 Monitoring of functions and integrity

In case a failure is detected in one or more of the following functions or data, an alarm / indication shall be triggered and the system shall react as given in table Table 2.

Table 2 Integrity alarm conditions

alarms description text	alarm condition flag	alarm ID	reaction of the system
AIS: Tx malfunction	A	001	Stop transmission
AIS: Antenna VSWR exceeds limit	A	002	Continue operation
AIS: Rx channel 1 malfunction	A	003	Stop transmission on affected channel

AIS: Rx channel 2 malfunction	A	004	Stop transmission on affected channel
AIS: Rx channel 70 malfunction	A	005	Stop transmission on affected channel
AIS: general failure	A	006	Stop transmission
AIS: UTC clock lost	V	007	Continue operation using indirect or semaphore synchronisation

6.10.3 Monitoring of sensor Data

6.10.3.1 Sensor data status

In case a sensor data status changes, an alarm / indication shall be given and the system shall react as given in Table 3:

Table 3 Sensor status indications

Indication / alarm description text	alarm condition flag	alarm ID	reaction of the system
AIS: external DGNSS in use	V	021	Continue operation
AIS: external GNSS in use	V	022	Continue operation
AIS: internal DGNSS in use (beacon)	V	023	Continue operation
AIS: internal DGNSS in use (msg 17)	V	024	Continue operation
AIS: internal GNSS in use	V	025	Continue operation
AIS: no valid sensor position	A	026	Continue operation (refer to Table 4)
AIS: external SOG / COG in use	V	027	Continue operation
AIS: internal SOG / COG in use	V	028	Continue operation
AIS: no valid SOG information	V	029	Continue operation using default data
AIS: no valid COG information	V	030	Continue operation using default data
AIS: Heading valid	V	031	Continue operation
AIS: Rate of turn valid	V	032	Continue operation
AIS: Heading lost/invalid	V	033	Continue operation using default data
AIS: Rate of turn lost/invalid	V	034	Continue operation using default data

6.10.3.2 Position sensor fallback conditions

Priorities and affected position report data (refer to ITU-R M.1371 A2/3.3.8.2.1) shall be as follows:

Table 4 Position sensor fallback conditions

Priority	Affected data in msg 1, 2, 3 ⇒ / Position Sensor status	position accuracy flag	Time Stamp	RAIM-Flag	Position Longitude / Latitude
1.	external DGNSS in use (corrected) [1]	1	UTC-sec	1 / 0 *	Lat/Lon (external)

[1] applicable in all configurations (minimum requirement)

2.	internal DGNSS in use (corrected; msg 17)**2**		1	UTC-sec	1 / 0 *	Lat/Lon (internal)
3.	internal DGNSS in use (corrected; beacon)3		1	UTC-sec	1 / 0 *	Lat/Lon (internal)
4.	external EPFS in use (uncorrected) [1]		0	UTC-sec	1 / 0 *	Lat/Lon (external)
5.	internal GNSS in use (uncorrected)[2]		0	UTC-sec	1 / 0 *	Lat/Lon (internal)
6.	no sensor position in use [1]	manual pos. input	0	61	0	Lat/Lon (manual)
		dead reckoning pos.		62		Lat/Lon (dead-reck.)
		no position		63		not. available=181/91

* if RAIM available “1”; if not, default “0”

The AIS shall automatically select the position source with the highest priority available. If data availability changes, the AIS shall automatically switch to the position source with the highest priority available after 5 s when switching downwards or 30 s when switching upwards.

During this period, the latest valid position shall be used for reporting.

On changeover from one status to another a new msg 5 shall be transmitted immediately when the reference point for the reported position has changed and an “ALR” sentence as described above shall be output to the presentation interface.

6.10.3.3 SOG / COG sensor fallback conditions

SOG/COG information from internal GNSS receiver shall be used, if this internal GNSS receiver is in use as a position source. This is to avoid transmission of information referenced to different points on the ship.

6.11 Display, input and output

The AIS shall provide means to display ship and shore based AIS data and manually input data as follows:

6.11.1 Required display and manual input functions

Display and manual input device to allow the following functions:

- Display of at least three (3) lines of data. Each line to display at least bearing, range, and name of ship. Horizontal scrolling of bearing and range is not allowed. The title of display data shall be visible.
- Manual input of voyage and safety related messages, control of AIS and data selection.

6.11.2 Alarms and status information

The following alarms and status information shall be indicated and the information contents displayed on request:

- alarms and indications as a result of the Built In Integrity Test (BIIT see 6.10)
- received safety related messages
- received long range interrogations.

A means to acknowledge alarms and indications as above shall be provided.

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[2] applicable only if internal GNSS receiver is used for position backup (see 6.2.2)

[3] applicable only if (optionally) an internal beacon receiver is provided

Means shall be provided to disable the acknowledgement of information as above e.g. in the case where an external alarm is provided.

7 Technical requirements

7.1 (M.1371/A2-1) General

This clause *covers layers 1 to 4 (Physical Layer, Link Layer, Network Layer, Transport Layer) of the Open System Interconnection (OSI) model.*

Figure 1 illustrates the layer model of an AIS station (Physical Layer to Transport Layer) and the layers of the applications (Session Layer to Application Layer):

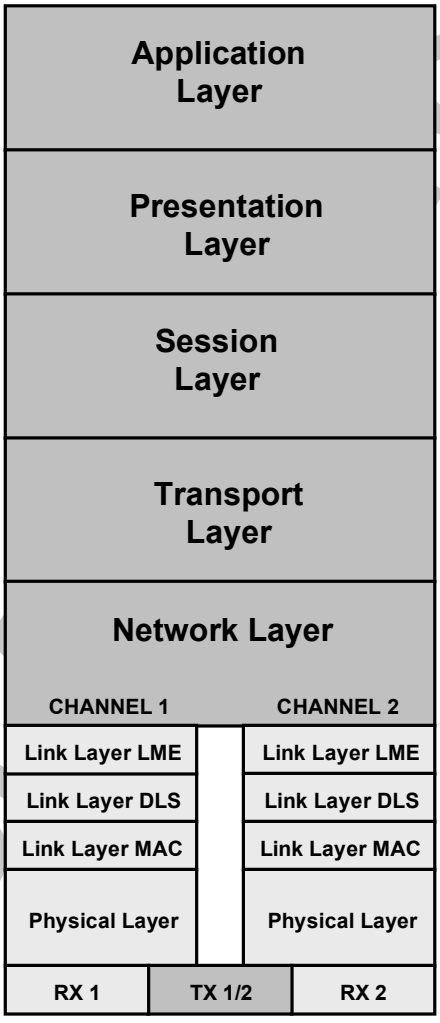


Figure 1 (M.1371/A2-1) OSI layer model

7.2 (M.1371/A2-2) Physical layer

The Physical layer is responsible for the transfer of a bit-stream from an originator out, on to the data link. The Physical Layer shall be designed in accordance with Recommendation ITU-R M.1371, Annex 2, Chapter 2.

The technical characteristics as specified in Table 5 shall apply to the TDMA receivers.

Table 5 Required receiver characteristics

Receiver Parameters	25kHz channels	12.5kHz channels
Sensitivity	20% PER for –107 dBm	20% PER for –104 dBm
Co-channel rejection	-10 – 0 dB	-18 – 0 dB
Adjacent channel selectivity	70 dB	50 dB
Spurious response rejection	70 dB	N/A
Intermodulation response rejection and Blocking	20 % PER	N/A

7.3 (M.1371/A2-3) Link layer

The Link layer specifies how data shall *be packaged in order to apply error detection and correction to the data transfer. The Link layer is divided into three (3) sublayers.*

7.3.1 (M.1371/A2-3.1) Link sublayer 1: Medium Access Control (MAC)

T*he MAC sublayer provides a method for granting access to the data transfer medium, i.e. the VHF data link. The method used* shall *be a Time Division Multiple Access (TDMA) scheme using a common time reference.* The Medium Access Control sublayer shall be designed in accordance with Recommendation ITU-R M.1371, Annex 2, Chapter 3.1.

7.3.2 (M.1371/A2-3.2) Link sublayer 2: Data Link Service (DLS)

The DLS sublayer provides methods for:

1) data link activation and release;

2) data transfer; or

3) error detection and control.

The Data Link Service sublayer shall be designed in accordance with Recommendation ITU-R M.1371-1, Annex 2, Chapter 3.2.

7.3.3 (M.1371/A2-3.3) Link sublayer 3 - Link Management Entity (LME)

The LME controls the operation of the DLS, MAC and the physical layer.

The Link Management Entity sublayer shall be designed in accordance with Recommendation ITU-R M.1371, Annex 2, Chapter 3.3.

Link sublayer 3 includes definition of VDL-messages (M.1371/A2-3.3.8 Table13).

Table 6 shows how the messages defined in M.1371/A2-3.2 shall be used by a Class A shipborne mobile AIS device. For further details refer to the appropriate section of M.1371.

Legend:

R/P - Receive and process internally, e. g. prepare for output via PI, act upon the received information, and use the received information internally.

O - Output message content via PI using PI VDM messages

T - Transmission by own station: "Yes" = either allowed or required; "No" = shall not be transmitted

INF - VDL message will be output via PI using a PI VDM message for information only. This function may be suppressed by configuration setting.

Table 6 Use of VDL messages

msg. No.	Name of message	M.1371 Ref.	R/P	O	T	Remark
0	Undefined	None	Yes	Yes	No	Reserved for future use
1	Position Report (Scheduled)	A2-3.3.8.2.1	Yes	Yes	Yes	
2	Position Report (Assigned)	A2-3.3.8.2.1	Yes	Yes	Yes	
3	Position Report (When interrogated)	A2-3.3.8.2.1	Yes	Yes	Yes	
4	Base Station Report	A2-3.3.8.2.2	Yes	Yes	No	
5	Static and Voyage Related Data	A2-3.3.8.2.3	Yes	Yes	Yes	
6	Addressed Binary Message	A2-3.3.8.2.4	Yes	Yes (1)	Yes	(1) Only if addressed to own station
7	Binary Acknowledge	A2-3.3.8.2.5	Yes	INF (2)	Yes	(2) An ABK PI message shall be sent to the PI in any case.
8	Binary Broadcast Message	A2-3.3.8.2.6	Yes	Yes	Yes	
9	Standard SAR Aircraft Position Report	A2-3.3.8.2.7	Yes	Yes	No	
10	UTC and Date Inquiry	A2-3.3.8.2.8	Yes	INF	Yes	
11	UTC / Date Response	A2-3.3.8.2.2	Yes	INF	Yes	
12	Addressed Safety Related Message	A2-3.3.8.2.9	Yes	Yes (3)	Yes	(3) Only if addressed to own station
13	Safety Related Acknowledge	A2-3.3.8.2.5	Yes	INF (4)	Yes	(4) An ABK PI message shall be sent to the PI in any case.
14	Safety Related Broadcast Message	A2-3.3.8.2.10	Yes	Yes	Yes	
15	Interrogation	A2-3.3.8.2.11	Yes	INF	Yes	class A shipborne mobile station may interrogate for msg 3, 4, 5, 9, 18, 19, 20, 21, 22
16	Assigned Mode Command	A2-3.3.8.2.12	Yes	INF	No	
17	GNSS Broadcast Binary Message	A2-3.3.8.2.13	Yes (5)	INF (6)	No	(5) only if internal GNSS receiver is capable of processing DGNSS corrections or PI contains an DGNSS output port (6) on other ports of the PI: INF
18	Standard Class B Equipment Position Report	A2-3.3.8.2.14	Yes	Yes	No	
19	Extended Class B Equipment Position Report	A2-3.3.8.2.15	Yes	Yes	No	
20	Data Link Management Message	A2-3.3.8.2.16	Yes	INF	No	
21	Aids-to-Navigation Report	A2-3.3.8.2.17	Yes	Yes	No	
22	Channel Management Message	A2-3.3.8.2.18	Yes	INF	No	
23 - 63	Undefined	None	Yes	Yes	No	Reserved for future use

7.4 (M.1371/A2-4) Network layer

The network layer shall *be used for:*

1) establishing and maintaining channel connections;

2) management of priority assignments of messages;

3) distribution of transmission packets between channels;

4) data link congestion resolution.

The Network Layer shall be designed in accordance with Recommendation ITU-R M.1371-1, Annex 2, Chapter 4.

7.5 (M.1371/A2-5) Transport layer

The transport layer shall *be responsible for:*

1) converting data into transmission packets of correct size;

2) sequencing of data packets;

3) interfacing protocol to upper layers.

The Transport Layer shall be designed in accordance with Recommendation ITU-R M.1371-1, Annex 2, Chapter 5.

7.6 (M.1371/A2-5) Presentation interface

The interface between the transport layer and higher layers shall *be performed by the Presentation Interface.*

7.6.1 (M.1371/A2-5.4) General

Data, which is to be transmitted by the AIS device, shall *be input via the Presentation Interface. Data, which is received by the AIS device,* shall *be output through the Presentation Interface. The formats and protocol used for this data stream* shall be *defined by the referenced IEC 61162 series.*

If no appropriate IEC 61162 format and protocol exist, other protocols may be used.

7.6.1.1 (M.1371/A4) Long Range Applications

Class A shipborne mobile equipment shall *provide a two-way interface for equipment which provides for long range communications. The interface shall comply with the IEC 61162 series.*

7.6.1.2 Composition

The Presentation Interface of the AIS shall comprise the data ports listed in Table 7. (Also see Annex D, "AIS Interface Overview (normative)")

Table 7 Presentation Interface Access

General Function	Mechanism
Automatic Input of Sensor Data (Sensor data input from shipboard equipment)	(3) IEC 61162-2 input ports, also configurable as IEC 61162-1 input ports
High Speed Input / Output Ports (Operator controlled commands and data input; AIS VHF Data Link (VDL) data; and AIS equipment status)	(2) IEC 61162-2 paired input and output ports
Long Range Communications	(1) IEC 61162-2 paired input and output ports
BITT Alarm Output	(1) Isolated normally-closed (NC) contact circuit

7.6.2 Automatic Input of Sensor Data

7.6.2.1 Required Ports

A minimum of three input ports shall be provided. Each port shall meet the requirements of IEC 61162-2 and be capable of being reconfigured to IEC 61162-1.

7.6.2.2 Interface Connector

The manufacturer shall specify the connector for these ports.

7.6.2.3 Format of Sensor Data

The sensor data shall be provided using the formats described in IEC 61162-1. As a minimum, the required IEC 61162-1 sentences listed in Table 8 (Preferred IEC 61162-1 Sentences) shall be received and processed by an AIS unit. Details for these sentences are contained in IEC 61162-1.

Table 8 Preferred IEC 61162-1 Sensor Sentences

Data	IEC 61162-1 Sentence formatters	
	required	optional
Reference datum	DTM	
Positioning system: Time of position Latitude / Longitude Position accuracy	GNS GLL	GGA , RMC
Speed Over Ground (SOG)	VBW	VTG, OSD, RMC
Course Over Ground (COG)	RMC	VTG, OSD
Heading	HDT	OSD
RAIM indicator	GBS	
Rate Of Turn (ROT)	ROT	
Route Plan	RTE and WPL	

The AIS shall use the DTM sensor sentence to automatically confirm that the position sensor provides position information in the WGS84 datum.

The reception of periodic GBS sentences, containing values for the parameters "expected error in latitude" and "expected error in longitude" shall be used to indicate with the "RAIM-Flag" that the position sensor is operating with a RAIM process in use.

Each of the data items listed in Table 8 (Preferred IEC 61162-1 Sentences) may be produced by various connected sensor equipment. The external sensor equipment is neither assigned to specific AIS input ports nor are the specified input sentences assigned to specific equipment. AIS shall be capable of accepting these specified sentences at each of the input ports.

7.6.3 High Speed Input / Output Ports

7.6.3.1 Required Ports

A minimum of two input / output ports shall be provided. A primary input/output port for connection of onboard control equipment, ECDIS, radar, etc., and a pilot/auxiliary input/output port for connection of ship's pilot equipment, service equipment, etc. Each port shall meet the requirements of IEC 61162-2.

Both input ports shall be functionally equivalent and shall be capable of receiving the data formats defined in Table 9 (AIS High-speed Input Data and Formats).

Both output ports shall be functionally equivalent and shall be capable of simultaneously transmitting the data formats defined in Table 12 (AIS High-speed Output Data and Formats).

7.6.3.2 Interface Connector

The manufacturer shall specify the connector for these ports.

7.6.3.3 Input Data and Formats

The AIS shall as a minimum be able to receive and process the input data shown in Table 9. The details of these sentences are contained in IEC 61162-1. Manufacturer's proprietary data may also be entered using these high-speed ports.

Table 9 AIS High-speed Input Data and Formats

Data	IEC 61162-1 Sentences
Normal Access - Parameter Entry	
Voyage Information: Vessel type and cargo category Navigational status Draught, max. actual static Destination ETA date and time Regional Application Flags	VSD - voyage static data
Station Information Vessel name Call sign Antenna location length and beam	SSD - Station static data
Initiate VHF Data-link Broadcasts	
Safety messages	ABM - Addressed Binary Message BBM - Broadcast Binary Message
Binary Messages	ABM - Addressed Binary Message BBM - Broadcast Binary Message
Interrogation Message	AIR - AIS Interrogation Information
AIS Equipment - Parameter Entry	
AIS VHF channel selection	ACA - AIS Channel Assignment Message
AIS VHF power setting	ACA - AIS Channel Assignment Message
AIS VHF channel bandwidth	ACA - AIS Channel Assignment Message
Transmit/Receive mode control	ACA - AIS Channel Assignment Message
MMSI	Integral display or proprietary sentences (limited access)
IMO number	Integral display or proprietary sentences (limited access)
Other AIS equipment controls	Integral display or proprietary sentences (limited access)
BIIT Input	
Alarm / indication acknowledgement	ACK Acknowledgement message

7.6.3.4 Output Data and Formats

The AIS shall as a minimum be able to generate and send the output data shown in Table 10.

The VDM sentence shall be sent simultaneously on both high-speed output ports for every VDL message received. Some VDL messages are informative according to Table 6 . During operation, the operator may disable delivery of these informative messages. Manufacturer's proprietary data may also be sent using these high-speed ports.

Table 10 AIS High-speed Output Data and Formats

Data	IEC 61162-1 Sentences
Prepared by AIS Unit	
Notification that a session initiated by messages ABM, BBM, AIR is terminated	ABK - Acknowledgement Message [M.1371/A2-5.4.1 and M.1371/A2-3.3.8.2.5]
AIS Own-ship Broadcast Data (all transmissions available)	VDO - VHF Data-link Own-vessel message)4
AIS equipment status (Built-in-integrity-test results)	ALR - (see 6.10.1.1)
Received on VHF Data-link by AIS Unit	
All VDL AIS messages received Broadcast or Addressed to own Station	VDM - VHF Data link Message

7.6.4 Long Range Communications

7.6.4.1 Required Ports

A minimum of one input / output port shall be provided and shall meet the requirements of IEC 61162-2. It may be connected to long-range communications equipment (e.g., satellite communications; see 9).

The input port shall be capable of receiving the data formats defined in Table 11(AIS Long range Communications Input Data and Formats).

The output port shall be capable of transmitting the data formats defined in Table 12(AIS Long range Communications Output Data and Formats).

7.6.4.2 Interface Connector

The manufacturer shall specify the connector for these ports.

7.6.4.3 Input Data and Formats

Long Range interrogation of an AIS unit is accomplished through the use of two IEC 61162-1 sentences - LRI and LRF. This pair of interrogation sentences provides the information needed by the AIS unit to determine if it must construct and provide the reply sentences - LR1, LR2, and LR3. The LRI-sentence contains the information needed to determine if the reply needs to be constructed. The LRF-sentence identifies the information that is being requested.

The information, that can be requested by the LRF-sentence, is shown in Table 11 (AIS Long Range Communications Input Data and Formats). These information items are the same as those defined in IMO Resolution A.851(20). The letters shown in parenthesises are from IMO Resolution A.851(20) and are used in the LRF-sentence. Details of these sentences are contained in IEC 61162-1.

———————

4 The VDO output for all broadcast VDL messages is for information purposes only. The VDO coded output is required but during operation it may be suppressed by the AIS configuration.

Table 11 AIS Long range Communications Input Data and Formats

Data	IEC 61162-1 Sentences
Long Range Interrogation Type of request Geographic area request AIS unit request	LRI - Long Range Interrogation
Long Range Function identification Requestor MMSI and Name Request for: Ship's name, call sign, and IMO number (A) Date and time of message composition (B) Position (C) Course over ground (E) Speed over ground (F) Destination and ETA (I) Draught (O) Ship / Cargo (P) Ship's length, breadth, and type (U) number of persons on board (W)	LRF - Long Range Function Identification

7.6.4.4 Output Data and Formats

The Long Range reply from the AIS unit is accomplished through the use of three IEC 61162-1 sentence formatters - LR1, LR2, and LR3. The AIS unit shall reply with these three sentences, in the following order; LR1, LR2, and LR3 when responding to an interrogation even if all the information items in the sentence are null.

The LR1-sentence identifies the destination for the reply and contains the information items requested by the "A" function identification character in the LRF-sentence.

The LR2-sentence contains the information items requested by the "B, C, E, and F" function identification characters in the LRF-sentence.

The LR3-sentence contains the information items requested by the "I, O, P,U and W" function identification characters in the LRF-sentence.

The individual information items shall be “null” if any of the following conditions exist:

- The information item was not requested in the LRF-sentence,
- The information item was requested but is not available, or
- The information item was requested but is not being provided.

The output data shown in Table 12 shall be provided when specifically requested by function identification characters contained in the preceding LRF-sentence portion of the interrogation. Details of these sentences are contained in 9 and in IEC 61162-1.

Table 12 LR Output Data Formats

Data	IEC 61162-1 Sentences
MMSI of Responder MMSI or Requestor Ship's Name Ship's call sign IMO Number	LR1 - Long Range Response, line 1
MMSI of Responder Date and time of message composition Position Course over ground Speed over ground	LR2 - Long Range Response, line 2
MMSI of Responder Destination and ETA Draught Ship / Cargo Ship's length, breadth, and type Number of persons on board	LR3 - Long Range Response, line 3

7.6.5 BIIT Alarm Output

The AIS shall provide a relay output (NC contact) indicating the state of the Built-In Integrity Test (BIIT) alarm function as specified in 6.10.1.2 .

The terminals shall be isolated from circuits and grounds in the AIS.

The AIS manufacturer's documentation shall specify the current and voltage capability of the alarm relay contacts.

8 (M.1371/A3) DSC compatibility

The AIS shall *be capable of performing limited AIS-related DSC operations conforming to the provisions of* Recommendation ITU-R M.1371-1, Annex 3.

9 (M.1371/A4) Long range applications

9.1 General

Class A shipborne mobile equipment shall *provide a two-way interface for equipment which provides for long range communications. This interface* shall *comply with IEC 61162.*

Long Range (LR) communications shall be only through the Presentation Interface using the IEC 61162-2 interface dedicated to this purpose as described in 7.6.4 .

The LR AIS data shall be displayed on the AIS display as described in 6.11 .

9.2 Interrogations and responses

LR information shall only be transmitted in response to an interrogation from a LR base station.

9.2.1 Manual and automatic response

The AIS transponder shall be capable of being set by the user to respond automatically or manually to LR interrogations. In case of automatic reply to LR interrogations, the display shall indicate that the system was LR interrogated until the indication is acknowledged by the operator. In case of manual reply to LR interrogation, the display shall indicate that the system was LR interrogated until the operator has replied to the interrogation or cancelled the reply on the manual input device as described in 6.11 .

9.2.2 Data formats and contents

The LR interface messages have taken into account the requirements of IMO Resolution A.851(20), Where such information is available to the AIS system this shall be used.

The LR data types available for transmission shall be derived from the AIS system as described in Table 13.

Table 13 LR data types

ID	data types Format	Remarks
A	Ship name / Call sign / MMSI / IMO number	MMSI number shall be used as a flag identifier
B	Date and time in UTC	Time stamp of message composition shall be given in UTC only. Day of month , hours and minutes
C	Position	WGS84; Latitude / Longitude degrees and minutes
D		not available
E	Course	Course over ground (COG) in degrees
F	Speed	Speed over ground (SOG) in knots and 1/10 knots
G, H		not available
I	Destination / ETA	at masters discretion; ETA time format see B
J, K, L, M, N		not available
O	Draught	actual maximum draught in 1/10 of meters
P	Ship / Cargo	see table M.1371 A2/3.3.8.2.3 Table 17
Q, R, S, T		not available
U	Length / Beam / Type	length and beam in meters type see M.1371 A2/3.3.8.2.3 Table 17, tonnage not available
V		not available
W	Number of persons on board	
X,Y		not available
Z		not used

9.2.3 Addressing AIS-units

LR interrogations shall be either by user ID (ship's MMSI) or by geographical area "all ships" call designating the North-Eastern corner and the South-Western corner of the Mercator projection rectangle, which describes the called area.

The first LR data transfer shall take place by LR interrogation initiated by a geographical area "All ships" call.

Succeeding LR data transfers shall take place by LR interrogation based on user ID (MMSI)

To avoid replies on succeeding geographical area "All ships" calls from the same base station, the AIS shall store the MMSI of the LR base station for 24 hours.

10 Test conditions

10.1 General

When a requirement in this standard is different from IEC 60945, the requirement in this standard shall take precedence.

10.2 Normal and extreme test conditions

10.2.1 Normal test conditions

10.2.1.1 Temperature and humidity

Temperature and humidity shall be within following range:

Temperature	+15° to +35° C
Humidity	20% to 75%

10.2.1.2 Power supply

The normal power supply for the tests shall be in accordance with IEC 60945 Cl. 5.2.1.

10.2.2 Extreme test conditions

Extreme test conditions are as specified in IEC 60945. Where required, test under extreme test conditions shall be a combination of dry heat and upper limit of supply voltage applied simultaneously and low temperature and lower limit of supply voltage applied simultaneously.

During type testing the power source to the equipment may be replaced by a test power source, capable of producing normal and extreme test voltages.

10.3 Standard Test environment

The EUT is tested in an environment using test equipment to simulate and to log VDL-messages (see **Error! Reference source not found.**). Standard environment consists of at least 5 simulated targets. The signal input level at the RF input port of the EUT for any simulated target shall be at least –100 dBm . Own ship sensor inputs to EUT will be simulated by the test system or other means. Operation is checked on channels in the maritime mobile band.

Channels in use shall be selected by manual input or channel assignment messages before starting tests.

10.4 Test Signals

10.4.1 Standard Test Signal Number 1

A DSC call with an individual station address and with command sets 103 (report your position) and 111 (report ship name) unless otherwise stated (refer to ITU-R M.825).

10.4.2 Standard Test Signal Number 2

For TDMA Type 1: A test signal consisting of an infinite series of 010101

10.4.3 Standard Test Signal Number 3

For TDMA Type 2: A test signal consisting of an infinite series of 00110011.

NOTE : Transmitters may have limitations concerning their maximum continuous transmit time and/or their transmission duty cycle. It is intended that such limitations are respected during testing.

10.5 Arrangements for test signals applied to the receiver input

Sources of test signals for application to the receiver input shall be connected in such a way that the source impedance presented to the receiver input is 50 Ω (See 10.8).

This requirement shall be met irrespective of whether one or more signals using a combining network are applied to the receiver simultaneously.

The levels of the test signals at the receiver input terminals (RF socket) shall be expressed in terms of dBm.

The effects of any intermodulation products and noise produced in the test signal sources shall be negligible.

10.6 Encoder for receiver measurements

Whenever needed and in order to facilitate measurements on the receiver, an encoder for the data system shall accompany the EUT, together with details of the normal modulation process. The encoder is used to modulate a signal generator for use as a test signal source.

Complete details of all codes and code format(s) used shall be given.

10.7 Waiver for receivers

If the manufacturer declares that both TDMA receivers are identical, the test shall be limited to one receiver and the test for the second receiver shall be waived. The test report shall mention this.

10.8 Impedance

In this standard the term "50 Ω" is used for a 50 Ω non-reactive impedance.

10.9 Artificial antenna (dummy load)

Tests shall be carried out using an artificial antenna which shall be a non-reactive non-radiating load of 50 Ω connected to the antenna connector.

NOTE: Some of the methods of measurement described in this standard for the transmitters, allow for two or more different test set ups in order to perform those measurements. The corresponding figures illustrate therefore one particular test set up, and are given as examples. In many of those figures, power attenuators (providing a non-reactive non-radiating load of 50 Ω to the antenna connector) have been shown. These attenuators are not "artificial antennas" as defined in 10.9. The method of measurement used shall be stated in the test report.

10.10 Facilities for access

All tests shall be performed using the standard ports of the EUT. Where access facilities are required to enable any specific test, these shall be provided by the manufacturer.

10.11 Modes of operation of the transmitter

For the purpose of the measurements according to this standard, there shall be a facility to operate the transmitter unmodulated.

Alternatively, the method of obtaining an unmodulated carrier or special types of modulation patterns may also be decided by agreement between the manufacturer and the test laboratory. It shall be described in the test report. It may involve suitable temporary internal modifications of the equipment under test. For instance in the case of direct Frequency Shift Keying (FSK), a means to continuously transmit a sequence containing only "zeros" and a sequence containing only "ones" is preferable.

10.12 Measurement uncertainties

Maximum values of absolute measurement uncertainties shall be as follows:

RF frequency	± 1 x 10^{-7}
RF power	± 0.75 dB
Adjacent channel power	± 5 dB
Conducted spurious emission of transmitter	± 4 dB
Conducted spurious emission of receiver	± 3 dB
Two-signal measurement	± 4 dB
Three-signal measurement	± 3 dB
Radiated emission of transmitter	± 6 dB
Radiated emission of receiver	± 6 dB
Transmitter attack time	± 20 %
Transmitter release time	± 20 %
Transmitter transient frequency (frequency difference)	± 250 Hz

For the test methods according to this standard, these uncertainty figures are valid to a confidence level of 95 %.

The interpretation of the results recorded in a test report for the measurements described in this standard shall be as follows:

a) the measured value related to the corresponding limit shall be used to decide whether an equipment meets the requirements of this standard;

b) the actual measurement uncertainty of the test laboratory carrying out the measurements, for each particular measurement, shall be included in the test report;

c) the values of the actual measurement uncertainty shall be, for each measurement, equal to or lower than the figures given in this clause (absolute measurement uncertainties).

11 Power supply, special purpose and safety tests

Tests for power supplies, special purposes and safety shall be performed as specified in IEC 60945 clauses 7, 11 and 12. Waivers as indicated in IEC60945 shall apply.

12 Environmental tests

Environmental tests shall be performed as specified in IEC 60945 clause 8.

The Performance Test to be used for the environmental tests is for the transmitter:

- frequency error (see 15.1.1)
- carrier power (see 15.1.2)
- channel switching (see 14.7)
- transmitter attack time (see 15.1.5)
- transmitter release time (see 15.1.6);

and for the receiver (both TDMA and DSC):

- sensitivity at 25 kHz and 12.5 kHz(see 15.3.1, 15.3.2, 15.4.1),
- channel switching time (see 14.7).

For the Performance Check to be used with the environmental tests, repeat test 14.1.1.

All environmental tests may be combined as appropriate with the tests required in 15, as agreed by the manufacturer in order to avoid duplication of testing.

13 E M C tests

Tests for EMC emissions shall be performed as specified in IEC 60945 Cl. 9.

Tests for EMC immunity shall be performed as specified in IEC 60945 Cl. 10.

To demonstrate compliance with the performance criteria for the EMC immunity tests, the EUT shall be set into autonomous mode using channels AIS1 and AIS2 with a reporting interval of 2 s in the standard test environment (10.3). The contents of the reports and the reporting intervals shall not be degraded during or after the test, as appropriate for the considered criterion.

Performance Criterion C of IEC 60945 shall be taken to mean that the functions of the EUT are self-recoverable i.e. without operation of controls.

14 Operational tests

14.1 (4.2) Operating modes / Capability

14.1.1 (4.2.1, M.1371 A2/3.3.5) Autonomous mode

14.1.1.1 Transmit Position reports

Method of measurement

Set up a test environment of at least 5 test targets. Record the VDL communication and check for messages of the EUT.

Required results

Confirm that the EUT transmits continuously and that the transmitted data complies with sensor inputs.

14.1.1.2 Receive Position reports

Method of measurement

Set up a test environment of at least 5 test targets.

a) Switch on Test targets, then start operation of the EUT
b) Start operation of the EUT, then switch on Test targets

Check the VDL communication and Presentation Interface outputs of the EUT.

Required results

Confirm that EUT receives continuously under conditions a) and b) and outputs the received messages via the PI.

14.1.2 (4.2.1 M.1371A2/3.3.6) Assigned mode

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Transmit an Assigned mode command msg 16 to the EUT with:

a) Slot offset and increment

b) Designated reporting rate.

Record transmitted messages.

Required results

Confirm that the EUT transmits position reports msg 2 according to defined parameters and reverts to SOTDMA msg 1 with standard reporting rate after 4 to 8 min.

14.1.3 (4.2.1 M.1371A2/3.3.2) Polled mode

14.1.3.1 Transmit an interrogation

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Initiate the transmission of an interrogation message (msg 15) by the EUT addressing 1 or 2 destinations according to message table (M.1371 table13) requesting the following responses :

- msg 3, msg 5 from mobile stations

- msg 4, msg 20, msg 22. from base stations

Record transmitted messages.

Required results

Check that EUT transmits the interrogation message (msg 15) as appropriate.

14.1.3.2 Interrogation response

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Apply an interrogation message (msg 15; EUT as destination) to the VDL according to message table (M.1371 table13) for responses with msg 3, msg 5 and slot offset set to defined value. Record transmitted messages and frame structure.

Required results

Check that the EUT transmits the appropriate interrogation response message as requested after defined slot offset. Confirm that the EUT transmits the response on the same channel as where interrogation was received.

14.1.4 (6.1 M1371 A2/3.3.8) Addressed operation

14.1.4.1 Transmit an addressed message

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Initiate the transmission of an addressed binary message (msg 6; EUT as source) according to message table (M.1371 table13) by the EUT. Record the transmitted messages.

Required results

Check that the EUT transmits the msg 6 as appropriate. Repeat test with the addressed safety related message (msg 12).

14.1.4.2 (4.2) Receive addressed message

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode.

a) Apply an addressed binary message (msg 6; EUT as destination) to the VDL.
b) Apply an addressed binary message (msg 6; other station as destination) to the VDL.

Record transmitted messages and frame structure.

Required results

Check that EUT transmits the appropriate acknowledgement message. Confirm that

a) EUT outputs the received message via the Presentation Interface.
b) EUT does not output the received message via the Presentation Interface.

14.2 (4.2 M.1371 A2/5.2.1) Multiple slot messages

14.2.1 5 slot messages (M.1371 A2 / 5.2.1)

Method of measurement

Apply a BBM sentence to the PI of EUT with a max. of 121 data bytes of binary data in order to initiate transmission of a binary message (msg 8).

Required results

Check that the message is transmitted in up to 5 slots accordingly.

14.2.2 Longer messages (M.1371 A2 / 5.2.1)

Method of measurement

Apply a BBM sentence to the PI of the EUT Presentation Interface with an information content not fitting in 5 slots (i.e. more than 121 data bytes of binary data containing only binary 1's).

Required results

Check that the message is not transmitted. Check that a negative acknowledgement is given on the presentation interface.

14.3 (6.5.1 M.1371 A2/3.3.8) Information content

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode.

a) Apply all static, dynamic and voyage related data to the EUT.
b) Simulate unavailable or invalid sensor data.
c) Apply a non WGS84 or unspecified (no DTM) position input.
d) Apply a low accuracy position input (e. g. GNSS uncorrected).

Record all messages on VDL and check the contents of position report msg 1 and static data report msg 5.

Required results

a) Confirm that data transmitted by the EUT complies with manual and sensor inputs.

b) Confirm that data which is not available or invalid is set to default.

c) Confirm that only WGS84 data is used for transmission.

d) Confirm that accuracy field is set to “0”.

14.4 (6.5.2) Reporting rates

14.4.1 (6.5.2) Speed and course change

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode.

a) start with own speed of 10kn; record all messages on VDL for 10min and evaluate reporting rate for position report of EUT by calculating average slot offset over test period.

b) Increase speed and change course (ROT > 10°/min, derived from heading) in accordance with 6.5.2 Table 1 and ITU-R M.1371 A2/4.3.

c) Reduce speed and rotation rate to values below those given in Table 1.

d) Make speed and/or heading sensor unavailable.

For b), c), d) record all messages on VDL and check slot offset between two consecutive transmissions.

Required results

a) Reporting rate shall comply to Table 1 (10sec ±10%).

b) Confirm that the new reporting rate has been established after 2 transmissions ±20%.

c) Confirm that the reporting rate is reduced after 4min (speed reduction) or 20sec (ROT reduction).

d) Check that with unavailable sensors the reporting rate reverts to default values (10sec if no sensor connected).

14.4.2 (6.5.2) Change of navigational status

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Change Navigational status by applying voyage data message to the Presentation Interface of the EUT.

a) set NavStatus to ”at anchor” and speed <3 kn

b) set NavStatus to “at anchor” and speed >3 kn

c) set NavStatus to other values

Record all messages on VDL and evaluate reporting rate of position report of EUT.

Required results

a) Reporting rate shall be 3min.

b) Reporting rate shall be 10 sec.

c) Reporting rate shall be adjusted according to speed and course (see 14.4.1)

14.4.3 (6.5.2) Assigned reporting rates

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Transmit an Assigned mode command msg 16 to the EUT with:

a) initial slot offset and increment;

b) designated reporting rate.

Change course, speed and NavStatus. Record transmitted messages.

Required results

Confirm that the EUT transmits position reports msg 2 according to the parameters defined by msg 16; the reporting rate shall not be affected by course, speed or NavStatus. The EUT shall revert to msg 1 in autonomous mode with standard reporting rate after 4 to 8 min.

14.4.4 (6.5.2) Static data reporting rates

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode.

a) Record the transmitted messages and check for static and voyage related data (msg 5).

b) Change static and/or voyage related station data. Record the transmitted messages and check for static and voyage related data (msg 5).

Required results

a) Confirm that the EUT transmits msg 5 with a reporting rate of 6 min.

b) Confirm that the EUT transmits msg 5 within 1 min reverting to a reporting rate of 6 min.

14.5 (6.6) Security

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Switch the EUT off for more than 15 min and on again at least ten times. Recover and readout recorded data.

Required results

Confirm that the EUT records and displays times and events correctly.

14.6 (6.7 M.1371 A2/3.3.3) Initialisation period

Method of measurement

Set up standard test environment with all sensors available.

a) Switch on EUT with EUT operating in autonomous mode.

b) Switch off EUT for approx. 0.5 s. Record transmitted messages.

Required results

Confirm that the EUT starts transmissions within 2 min after switch on.

14.7 (6.9) Channel selection

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Switch the EUT to different channels randomly selected from the maritime mobile band as specified by ITU-R

M.1084-4, Annex 4 using both 25kHz and 12.5kHz channel spacing (incl. 12.5kHz emission on a 25kHz channel):

a) manually,

b) by transmission of channel management message (msg 22) broadcast and addressed to EUT,

c) by application of ACA sentence to the presentation interface.

Record the VDL messages.

Required results

Confirm that the EUT switches to Channel / bandwidth and duplex / simplex channels accordingly.

14.8 (6.9 ; M.1371 A2/2.14, 2.15) Transceiver protection

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Open circuit and short circuit VHF-antenna terminals of the EUT for at least 60 s each.

Required results

The EUT shall be operative again within 2 min after refitting the antenna without damage to the transceiver.

14.9 (6.10) Alarms and indicators, fall-back arrangements

14.9.1 (6.10.1.2) Loss of power supply

Method of measurement

Disconnect power supplies of the EUT.

Required result

Verify that the relay output is “active” when the power is “off”.

14.9.2 (6.10.2) Monitoring of functions and integrity

14.9.2.1 Tx malfunction

Method of measurement

Disable the transmitter by disconnecting the antenna.

Required result

Verify that an alarm sentence ALR with alarm ID 001 is sent and the relay output signals the failure state.

Verify that relay deactivates when the EUT receives an ACK and that the status field in the ALR sentence is updated.

14.9.2.2 Antenna VSWR

Method of measurement

Prevent the EUT from radiating with full power by mismatching the antenna for a VSWR of 3:1 .

Required result

Verify that the EUT continues transmitting. Verify that an alarm sentence ALR with alarm ID 002 is sent and the relay output signals the failure state.

Verify that relay deactivates when the EUT receives an ACK and that the status field in the ALR sentence is updated.

14.9.2.3 Rx malfunction

Manufactures shall provide documentation describing how the AIS detects Rx malfunction and that an ALR sentence with alarm ID as appropriate is sent.

14.9.2.4 Loss of UTC

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Disconnect the GNSS antenna (UTC clock lost).

Required result

Verify that the system continues to operate but changes to indirect synchronisation and that an alarm sentence ALR with alarm ID 007 is sent and the relay output signals the failure state.

14.9.3 (6.10.3) Monitoring of sensor data

14.9.3.1 (6.1.1.3, 6.10.3) Priority of position sensors

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Verify the manufacturer's documentation to ascertain the configuration implemented on the EUT for position sensors (see 6.2).

Apply position sensor data in a way that the EUT operates in the states defined below :

a) external DGNSS in use (corrected)
b) internal DGNSS in use (corrected; msg 17) if implemented
c) internal DGNSS in use (corrected; beacon) if implemented
d) external EPFS in use (uncorrected)
e) internal GNSS in use (uncorrected) if implemented
f) no sensor position in use

Check the ALR sentence and the position accuracy flag in the VDL msg 1.

Required result

Verify that the use of position source, position accuracy flag, RAIM flag and position information complies to Table 4.

Verify that when the status is changed, an ALR sentence is sent according to Table 3.

Verify that the status is changed after 5 s when switching downwards and 30 s when switching upwards.

14.9.4 (6.10.3.1) Heading sensor

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode.

a) Disconnect the inputs for HDG and ROT or set their data to invalid (e.g. by wrong checksum, "valid/invalid" flag).

b) Reconnect the inputs for HDG and ROT

Required Result

a) Check that an alarm sentence ALR with alarm ID 033 for invalid HDG and ID 034 for invalid ROT is sent to the PI and the "default" data is sent in VDL msg 1,2 or 3.

b) Check that an alarm sentence ALR with alarm ID 031 for valid HDG and ID 032 for valid ROT is sent to the PI .

Verify that in the alarm sentence ALR the alarm condition flag is set to "V" and that the relay output is not activated.

14.9.5 (6.10.3.3) Speed sensors

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Verify the manufacturer's documentation to ascertain the configuration implemented on the EUT for position sensors (see 6.10).

a) apply valid external DGNSS position and external speed data.

b) disconnect external DGNSS position, disconnect the inputs for SOG, COG or set their data to invalid (e.g. by wrong checksum, "valid/invalid" flag) .

NOTE: Test b) is applicable only if the internal GNSS is used as position source.

Required Result

a) Check that an alarm sentence ALR with alarm ID 027 is sent to the PI and the external data for SOG / COG is sent in VDL msg 1, 2 or 3. Verify that the system continues to operate and that the relay output is not activated.

b) Check that an alarm sentence ALR with alarm ID 028 is sent to the PI and the internal data for SOG / COG is sent in VDL msg 1, 2 or 3. Verify that the system continues to operate and that the relay output is not activated.

14.10 (6.11) Display and control

14.10.1 Data input/output facilities

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode.

a) Check size of minimum display

b) Record received messages and check contents of minimum display.

c) Input static and voyage related data via the minimum display

Required results

a) Minimum display shall contain 4 lines of 16 char/line at least.

b) Confirm that all messages including binary and safety related and Long Range messages received can be displayed and that means to select messages and data fields to be displayed are available.

c) Confirm that all necessary data can be input.

14.10.2 Initiate message transmission

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Initiate the transmission of non scheduled messages and interrogations as provided by the EUT.

Required results

Confirm that at least the transmission of safety related addressed and broadcast messages (msg 12 and msg 14) can be initiated by means of the minimum display. Confirm that transmission of messages 4, 16, 17, 18, 19, 20, 21, 22 is not possible.

NOTE: Use of messages 4, 16, 17, 18,19, 20, 21, 22 is restricted to base stations or class B AIS.

14.10.3 System control

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Perform system control / configuration commands as specified. Check indication of system status / alarms.

Required results

At least initiation of channel switching shall be possible with the minimum display. Output power may not be switched manually. Confirm that the configuration level and other functions, not intended for use by the operator, are protected by password or adequate means.

15 Physical Tests

15.1 TDMA Transmitter

15.1.1 (M1371/A2-2.4.3) Frequency Error

Definition

The frequency error of the transmitter is the difference between the measured carrier frequency in the absence of modulation of the transmitter and its required frequency.

Method of measurement

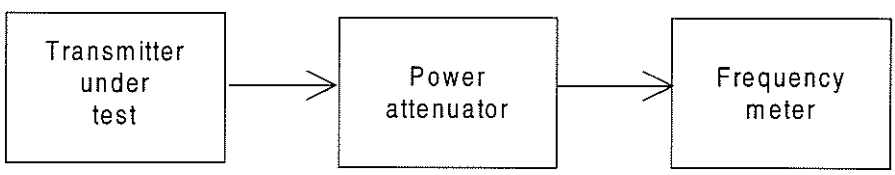


Figure 2 Measurement arrangement

The equipment shall be connected as illustrated.

The carrier frequency shall be measured in the absence of modulation. The measurement shall be made under normal test conditions and extreme test conditions.

Tests shall be performed on 4 channels (156.025 MHz, 157.4125 MHz, 160.6375 MHz, 162.025 MHz).

Required results

The frequency error shall not exceed ±0.5 kHz, under normal and ±1 kHz under extreme test conditions.

15.1.2 (M1371/A2-2.13.2) Carrier Power

Definition

The transmitter carrier power (conducted) is the mean power delivered to a nominal 50 Ohm load during a radio frequency cycle. The rated output power is the carrier power (conducted) defined as nominal High and Low

NOTE: The equipment is designed to operate with different carrier powers. This measurement shall be performed at the nominal low and nominal high power setting.

Method of measurement

The measurement shall be carried out under normal and extreme test conditions on both high and low power settings.

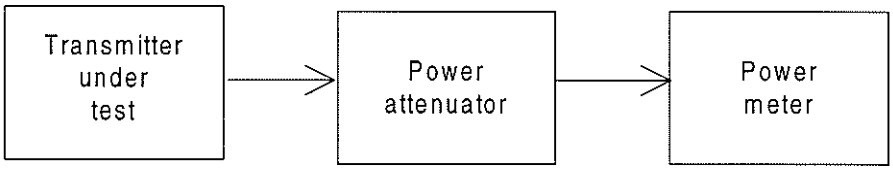


Figure 3 Measurement arrangement

Required results

The carrier power (conducted) shall be within ± 1,5 dB of the rated carrier power (conducted).

The carrier power (conducted) under extreme test conditions shall be within + 2,0 dB and - 3,0 dB of the rated output power.

15.1.3 (M1371/A2-2.4.2) Modulation Spectrum 25 kHz channel mode

Method of measurement

This test is produced to insure that the modulation sidebands produced by the specified test patterns, fall within the allowable masks.

Two methods of measurements are accepted.

a) The test shall be performed using the modulation and transmitter keying of the EUT.

b) Alternatively, to perform this test the manufacturer shall provide access to the modulator and the transmitter key. An external test signal shall be applied to the EUT.

The test shall be carried out using standard modulation, for both DSC and TDMA modes, using successively standard test signals 1, 2 and 3. See 10.4.

Using standard modulation, for both DSC and TDMA modes, the emission mask for 25kHz channel mode is:

- At ±10kHz removed from the carrier, the modulation sidebands is below - 25dBc.

- At ±25kHz removed from the carrier, the modulation sidebands is below - 70dBc, without any need to be below 0.25μW.

In the region between ±10kHz and ±25kHz removed from the carrier, the modulation sidebands is below a line specified between these two points.

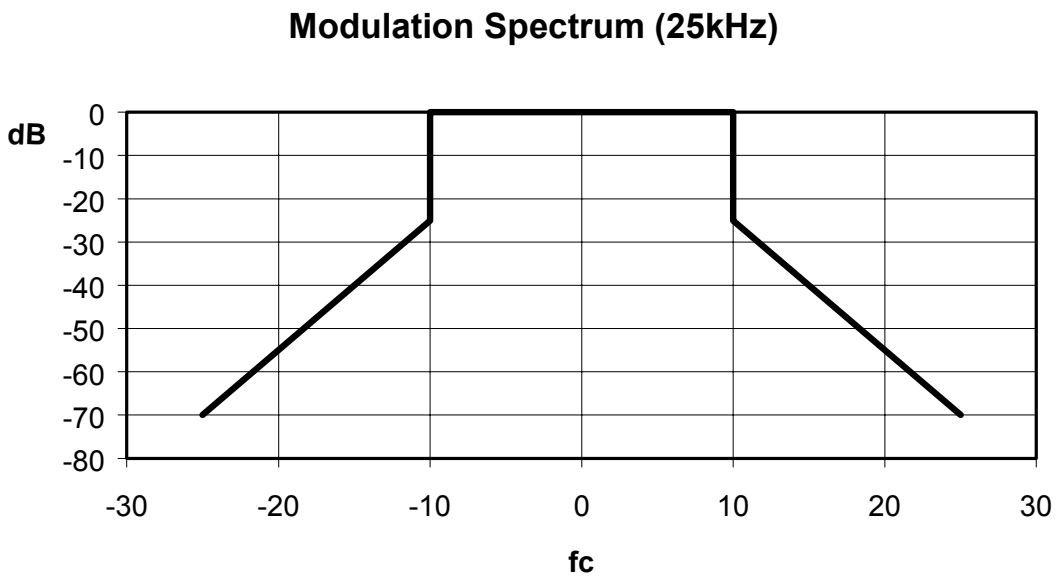


Figure 4 Modulation spectrum 25kHz

Required result

The modulation spectrum shall be within the mask specified in Figure 4.

15.1.4 (M1371/A2-2.4.2) Modulation Spectrum 12.5 kHz channel mode

Method of measurement

This test is produced to insure that the modulation sidebands produced by the specified test patterns, fall within the allowable masks.

Two methods of measurements are accepted.

a) The test shall be performed using the modulation and transmitter keying of the EUT.

b) Alternatively, to perform this test the manufacturer shall provide access to the modulator and the transmitter key. An external test signal shall be applied to the EUT.

The test shall be carried out using standard modulation in TDMA mode, using successively standard test signals 2 and 3. See 10.4.

The emission mask for 12.5 kHz channel mode is:

At ±12.5 kHz removed from the carrier, the modulation sidebands is below –60 dBc

In the region between ±2.5 kHz and ±12.5 kHz removed from the carrier, the modulation sidebands is below a line starting at 0 dBc / ±2.5 dBc and ending at –60 dBc / ±12.5 kHz without any need to be below 0.25 μW.

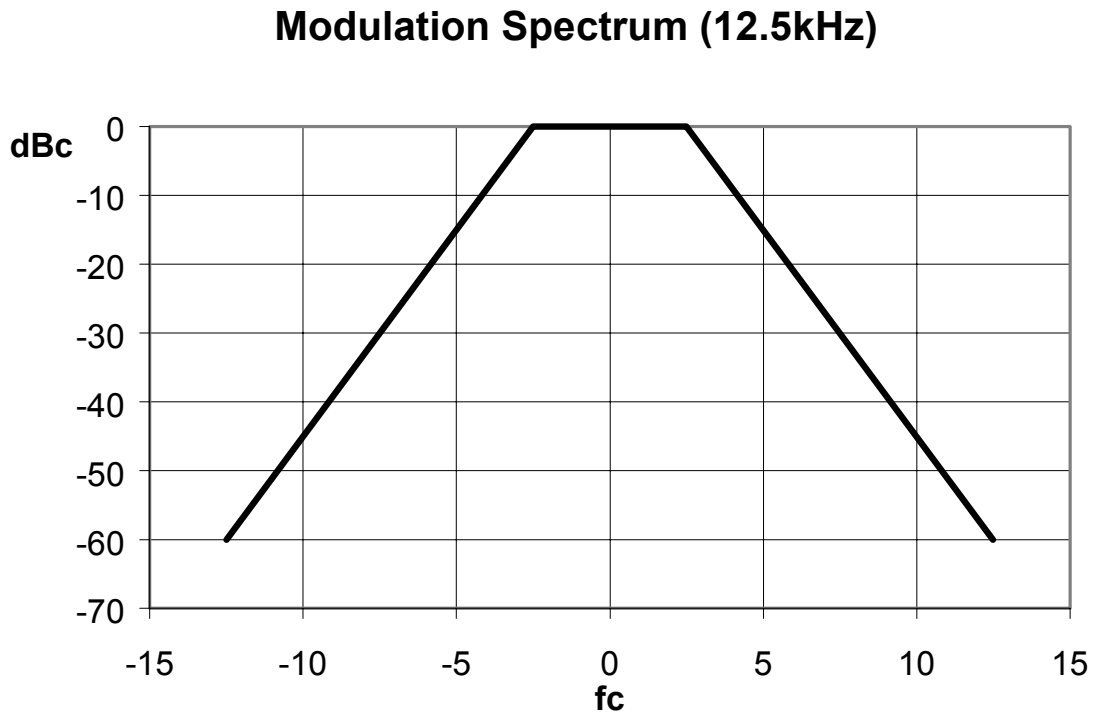


Figure 5 Modulation spectrum 12.5 kHz

Required result

The modulation spectrum shall be within the mask specified in Figure 5.

15.1.5 (M1371/A2-2.12.1) Transmitter Attack Time

Definition

The transmitter attack time (t_a) is the time which elapses between the initiation of the "transmitter on" function (T_o, see figure 3.2.2.10 in Rec. ITU-R M.1371-1) and:

a) The moment when the transmitter output power has reached a level 1 dB below or 1,5 dB above the steady state power (P_c) and maintains a level within +1,5 dB / -1 dB from P_c thereafter as seen on the measuring equipment or in the plot of power as a function of time; or

b) The moment after which the frequency of the carrier always remains within ±1 kHz of its steady state frequency, F_c , as seen on the measuring equipment or the plot of frequency as a function of time, whichever occurs later.

The choice of conditions for b), above, is made in order to make the method of measurement easier to perform and to have good repeatability. Under these conditions, the frequency of the carrier shall be within the required frequency tolerance a few ms after the end of the attack time as defined in b) above.

Method of measurement

The measurement is carried out with an unmodulated carrier.

The measurement procedure shall be as follows:

a) The transmitter is connected to a RF detector and to a test discriminator via a matched test load. The attenuation of the test load shall be chosen in such a way that the input of the test discriminator is protected against overload and the limiter amplifier of the test discriminator operates correctly in the limiting range as soon as the transmitter carrier power (before attenuation) exceeds 1 mW. A dual trace storage oscilloscope (or a transient recorder) records the amplitude transient from the detector on a logarithmic scale and the frequency transient from the discriminator;

A trigger device may be required to ensure that the start of the sweep of the oscilloscope time base occurs at the instant at which the "transmitter on" function is initiated. The measuring arrangement is shown in figure 8 below.

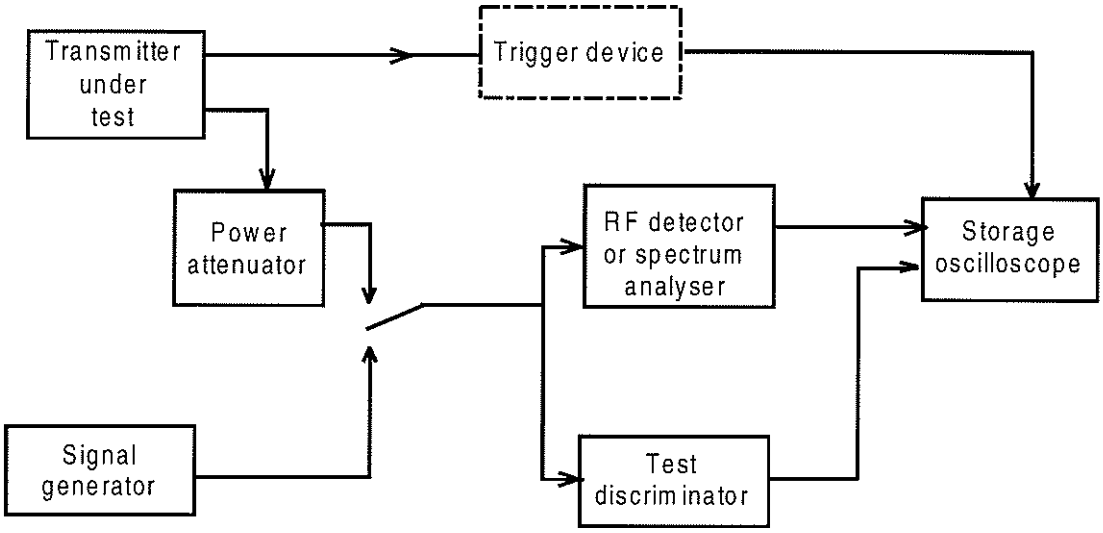


Figure 6 Test arrangement for transient behaviour of transmitter power and frequency, including transmitter attack and release time

The test discriminator may consist of a mixer and a local oscillator (providing the auxiliary frequency) used to convert the transmitter frequency to be measured into the frequency fed to the (broadband) limiter amplifier and the associated broadband discriminator:

- the test discriminator shall be sensitive enough to measure input signals down to Pc - 30 dB;
- the test discriminator shall be fast enough to display the frequency deviations (approximately 100 kHz/100 ms);
- the test discriminator output shall be dc coupled.

A spectrum analyser and a test discriminator/storage oscilloscope can also be used.

b) The traces of the oscilloscope shall be calibrated in power and frequency (y-axis) and in time (x-axis), using the signal generator;

c) The transmitter attack time may (preferably) be measured by direct reading on the oscilloscope while the transmitter is unmodulated.

Required result

The transmitter attack time shall not exceed 1 ms, and the transient power level shall not exceed +1.5 dB of its final value at any time. The carrier frequency shall not exceed +/- 1 kHz of its required value after 1 ms.

15.1.6 (M1371/A2-2.12.3) Transmitter Release Time

Definition

The transmitter release time (t_r) is the time which elapses between the initiation of the "transmitter off" function and the moment when the transmitter output power has reduced to a

level 50 dB below the steady state power (P_C) and remains below this level thereafter as seen on the measuring equipment or in the plot of power as a function of time.

Method of measurement

For the test arrangement, see paragraph 15.1.5 Figure 6.

The measurement is carried out with an unmodulated carrier.

The measurement procedure shall be as follows:

a) The transmitter is connected to a RF detector and to a test discriminator via a matched power attenuator. Its attenuation shall be chosen in such a way that the input of the test discriminator is protected against overload and that the limiter amplifier of the test discriminator operates correctly in the limiting range as long as the transmitter carrier power (before attenuation) exceeds 1 mW. A dual trace storage oscilloscope (or a transient recorder) records the amplitude transient from the detector on a logarithmic scale and the frequency transient from the discriminator. A trigger device may be required to ensure that the start of the sweep of the oscilloscope timebase occurs the instant at which the "transmitter off" function is initiated. If the transmitter possesses an automatic powering down facility (e.g. in the case of fixed length message transmission), it may replace the trigger device for starting the sweep of the oscilloscope.

   A spectrum analyser and a test discriminator/storage oscilloscope may also be used.

b) The traces of the oscilloscope shall be calibrated in power and frequency (y-axis) and in time (x-axis) by replacing the transmitter and test load by the signal generator;

c) The transmitter release time shall be measured by direct reading on the oscilloscope while the transmitter is preferably unmodulated.

Required result

The transmitter release time shall not exceed 1 ms.

15.2 (ITU-R M.825-3) DSC Transmissions

15.2.1 Frequency error of the DSC Signal

Definition

The frequency error for the B (2100Hz) and Y (1300Hz) state is the difference between the measured frequency from the demodulator and the nominal values.

Method of measurement

The transmitter shall be connected to the artificial antenna as specified in 10.11 and a suitable FM demodulator. The transmitter shall be set to channel 70.

The equipment shall be set to transmit a continuous B or Y state.

The measurement shall be performed by measuring the modulated output, for both the continuous B and Y state.

The measurements shall be carried out under normal and extreme test conditions.

Required results

The B and Y state frequencies for both normal and extreme test conditions shall be within +/- 1%.

15.2.2 Modulation Rate

Definition

The modulation rate is defined as the bit stream speed measured in bit/s.

Method of Measurement

The equipment shall be set to transmit continuous dot pattern. The RF output terminal of the equipment shall be connected to a linear FM demodulator followed by a suitable FSK demodulator.

Required results

The baud rate shall be 1200 bits/sec ± 30 ppm.

15.3 (7.2) TDMA Receivers

15.3.1 (7.2) Sensitivity – 25kHz Operation

Definition

The maximum usable sensitivity (data or messages, conducted) is the minimum level of signal (dBm) at the receiver input, produced by a carrier at the nominal frequency of the receiver, modulated with the normal test signal, which will, without interference, produce after demodulation a data signal with a specified packet error rate (PER).

Method of Measurement

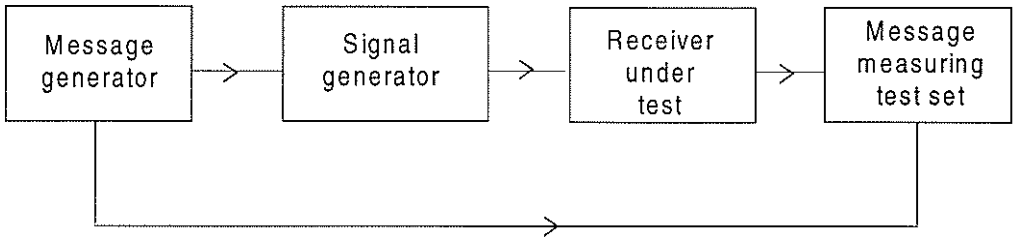


Figure 7 Measurement arrangement

Table 14

Parameter	Bits
Preamble	24
Start flag	8
Data	168
CRC	16
End flag	8
Total	224

Two (2) types of packets shall be used: one which has a data field with a bit pattern consisting of alternating ones and zeroes (101010101…), one, which has a bit pattern with alternating double ones and double zeroes (110011001100…). The test shall alternate between the two types during the test process.

NOTE: A broadcast binary message structure is allowed to be used for this test. In this case, the data field is reduced by 40 bits, which will be occupied by the message id for broadcast binary message and the unique

identifier for the transmitting station (MMSI). The application identifier shall be selected so that it corresponds with the selected bit pattern.

A minimum of 1000 packets shall be transmitted during the test. The PER shall be derived by dividing the received packets with the number of transmitted packets. The test shall be performed with the frequencies 156.025 MHz and 162.025 MHz.

Required results

The sensitivity shall be –107 dBm under normal test conditions, and –101 dBm under extreme test conditions, when operating on a 25 kHz channel with a PER of 20% (This corresponds to a BER of $10^{-3)}$.

15.3.2 (7.2) Sensitivity – 12.5kHz Operation

Definition

The maximum usable sensitivity (data or messages, conducted) is the minimum level of signal (dBm) at the receiver input, produced by a carrier at the nominal frequency of the receiver, modulated with the normal test signal, which will, without interference, produce after demodulation a data signal with a specified packet error rate (PER).

Method of measurement

Use the method of 15.3.1. The test shall be performed with the frequencies 157.4125 MHz and 160.6375 MHz.

Required result

The sensitivity shall be –104 dBm under normal test conditions, and –98 dBm under extreme test conditions, when operating on a 12.5 kHz channel with a PER of 20% (This corresponds to a BER of $10^{-3)}$.

15.3.3 (7.2) Error Behaviour at High Input Levels

Definition

The error behaviour (performance) at high input levels (noise free operation) is defined in the same manner as for the measurement of the maximum usable sensitivity when the level of the wanted signal is significantly above the maximum wanted sensitivity.

Method of measurement

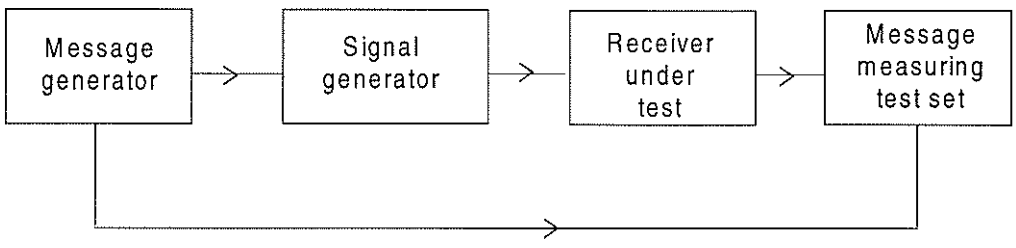


Figure 8 Measurement arrangement

The measurement procedure shall be as follows:

a) an input signal with a frequency equal to the nominal frequency of the receiver, having normal test modulation (see 10.4.2 and 10.4.3), in accordance with the instructions of the manufacturer and agreed by the testing laboratory, shall be applied to the receiver input terminals;

b) the level of the input signal shall be adjusted to a level which is –77 dBm for the degradation measurements;

c) the normal test signal shall then be transmitted 100 times whilst observing in each case whether or not a message is successfully received;

d) the number of messages not successfully received shall be recorded;

e) the measurement shall be repeated with the input signal of the receiver at a level of –7 dBm for the degradation measurements.

Required results

The number of messages not correctly received (lost or corrupted) shall not exceed 1 at –7dBm.

15.3.4 (7.2) Co-Channel Rejection – 25kHz Operation

Definition

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due the presence of an unwanted modulated signal, both signals being at the nominal frequency of the receiver.

Method of measurement

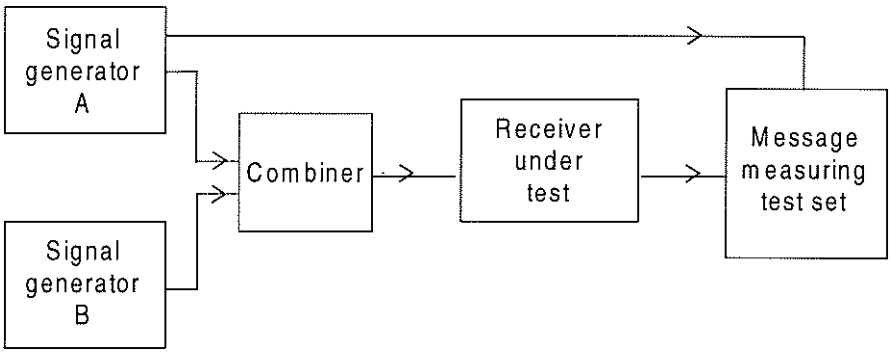


Figure 9 Measurement arrangement with messages

The measurement procedure shall be as follows:

a) Two signal generators, A and B, shall be connected to the receiver via a combining network.

The wanted signal, provided by signal generator A, shall be at the nominal frequency of the receiver and shall have normal test modulation (see 10.4).

The unwanted signal, provided by signal generator B, shall be modulated with a 400 Hz signal with a deviation of 12 % of the channel separation. Both input signals shall be at the nominal frequency of the receiver.

b) Initially, signal generator B (unwanted signal) shall be switched off (maintaining the output impedance).

The level of the wanted signal from generator A shall be adjusted to a level which is 6 dB above the level of the limit of the maximum usable sensitivity as specified in 15.3.1 at the receiver input terminals (i.e. 6 dB above –107 dBm under normal test conditions).

c) Signal generator B shall then be switched on, and the level of the unwanted signal adjusted until a successful message ratio of less than 10 % is obtained.

d) The normal test signal (see 10.4) shall then be transmitted repeatedly while observing in each case whether or not a message is successfully received.

The level of the unwanted signal shall be reduced by 2 dB for each occasion that a message is not successfully received.

The procedure shall be continued until three consecutive messages are successfully received. The level of the input signal shall then be noted.

e) The level of the unwanted signal shall be increased by 1 dB and the new value noted.

The normal test signal (see 10.4) shall then be transmitted 20 times. In each case, if a message is not successfully received the level of the unwanted signal shall be reduced by 1 dB and the new value noted.

If a message is successfully received, the level of the unwanted signal shall not be changed until three consecutive messages have been successfully received. In this case the unwanted signal shall be increased by 1 dB and the new value noted.

No level of the unwanted signal level shall be noted unless preceded by a change in level.

The average of the values noted in steps b) and c) (which provides the level corresponding to the successful message ratio of 80 %) shall be noted.

f) For each frequency of the unwanted signal, the co-channel rejection ratio shall be expressed as the ratio, in dB, of the average level noted in step c) to the level of the wanted signal, at the receiver input. This ratio shall be recorded.

g) The measurement shall be repeated for displacements of the unwanted signal of ±12 % of the channel separation.

h) The co-channel rejection of the equipment under test shall be expressed as the lowest of the three values expressed in dB, calculated in step d).

The value of the co-channel rejection ratio, expressed in dB, is generally negative (therefore, for example, - 12 dB is lower than - 8 dB).

i) Repeat this test using test signal 2 (as defined in 10.4.2) in place of signal generator B.

j) Repeat test i) using test signal 2 adjusted to a level of –7dBm.

Required result

The value of the co-channel rejection ratio, expressed in dB, at the signal displacements given in the method of measurement, shall be between -10,0 dB and 0 dB. Any positive value is also acceptable.

15.3.5 (7.2) Co-Channel Rejection – 12.5kHz Operation

Definition

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due the presence of an unwanted modulated signal, both signals being at the nominal frequency of the receiver.

Method of measurement

Use the method of 15.3.4.

Required result

The value of the co-channel rejection ratio, expressed in dB, at the signal displacements given in the method of measurement, shall be between - 18,0 dB and 0 dB. Any positive value is also acceptable.

15.3.6 (7.2) Adjacent Channel selectivity - 25kHz Operation

Definition

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended.

Method of measurement

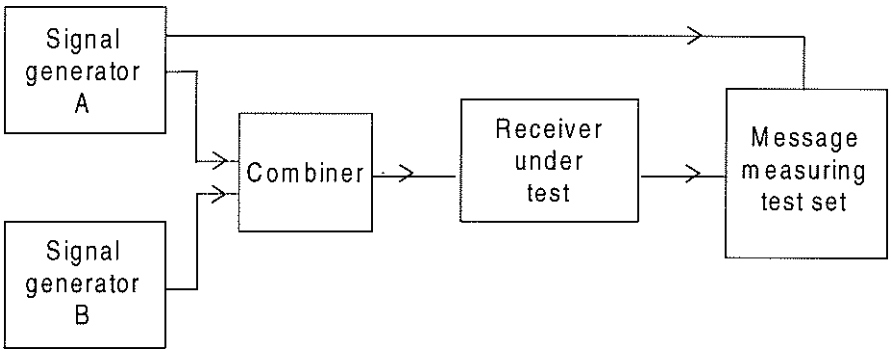


Figure 10 Measurement arrangement with messages

The measurement procedure shall be as follows:

a) Two signal generators, A and B, shall be connected to the receiver via a combining network.

The wanted signal, provided by signal generator A, shall be at the nominal frequency of the receiver and shall be modulated by the normal test signal (see 10.4).

The unwanted signal, provided by signal generator B, shall be an unmodulated signal and shall be at the frequency of the channel immediately above that of the wanted signal.

b) Initially, signal generator B (unwanted signal) shall be switched off (maintaining the output impedance).

The level of the wanted signal from generator A shall be adjusted to the level which is 3 dB above the level of the limit of the maximum usable sensitivity as specified in subclause 15.3.1, at the receiver input terminals (i.e. 6 dB above –113 dBm under normal test conditions).

c) Signal generator B shall then be switched on, and the level of the unwanted signal adjusted until a successful message ratio of 10 % is obtained.

d) The normal test signal 10.4 shall be transmitted repeatedly whilst observing in each case whether or not a message is successfully received.

e) The level of the unwanted signal shall be reduced in steps of 2 dB for each occasion that a message is not successfully received.

The procedure shall be continued until three consecutive messages are successfully received. The level of the input signal shall then be noted.

f) The level of the unwanted signal shall be increased by 1 dB and the new value noted.

The normal test signal (see 10.4) shall then be transmitted 20 times. In each case, if a message is not successfully received the level of the unwanted signal shall be reduced by 1 dB and the new value noted.

If a message is successfully received, the level of the unwanted signal shall not be changed until three consecutive messages have been successfully received. In this case the unwanted signal shall be increased by 1 dB and the new value noted.

No level of the unwanted signal shall be noted unless preceded by a change in level.

g) The average of the values noted in steps d) and e) (which provides the level corresponding to the successful message ratio of 80 %) shall be noted.

h) For each adjacent channel, the selectivity shall be expressed as the ratio, in dB, of the level of the unwanted signal to the level of the wanted signal, at the receiver input. This ratio shall be recorded.

i) The measurement shall be repeated with the unwanted signal at the frequency of the channel below that of the wanted signal.

j) The adjacent channel selectivity of the equipment under test shall be expressed as the lower of the two values measured in the upper and lower channels nearest to the receiving channel (see step f above).

k) The measurement shall be repeated under extreme test conditions (extreme temperature and extreme voltages applied simultaneously), using the level of the wanted signal, as specified in 15.3.1, increased by 6 dB.

Required results

The adjacent channel selectivity shall be no less than the values given in Table 15.

Table 15 Adjacent channel selectivity 25kHz

Channel separation	25 kHz
Normal test conditions	70,0 dB
Extreme test conditions	60,0 dB

15.3.7 (7.2) Adjacent Channel selectivity - 12.5kHz Operation

Definition

The adjacent channel selectivity is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended.

Method of measurement

Use the method in 15.3.6

Required results

The adjacent channel selectivity shall be no less than the values given in Table 16.

Table 16 Adjacent channel selectivity 12,5kHz

Channel separation	12,5 kHz
Normal test conditions	50,0 dB
Extreme test conditions	50,0 dB

15.3.8 (7.2) Spurious Response Rejection

Definition

The spurious response rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal at any other frequency, at which a response is obtained.

Method of measurement

To determine the frequencies at which spurious responses can occur the following calculations shall be made:

a) calculation of the "limited frequency range":

The limited frequency range is defined as the frequency of the local oscillator signal (f_{LO}) applied to the first mixer of the receiver plus or minus the sum of the intermediate frequencies ($f_{I1},...f_{In}$) and half the switching range (sr) of the receiver (156 – 163 MHz); hence, the frequency f_I of the limited frequency range is:

$$f_{LO} - \sum_{j=1}^{j=n} f_{Ij} - \frac{sr}{2} \leq f_I \leq f_{LO} + \sum_{j=1}^{j=n} f_{Ij} + \frac{sr}{2}$$

b) calculation of frequencies outside the limited frequency range:

A calculation of the frequencies at which spurious responses can occur outside the range determined in a) is made for the remainder of the frequency range of interest.

The frequencies outside the limited frequency range are equal to the harmonics of the frequency of the local oscillator signal (f_{LO}) applied to the first mixer of the receiver plus or minus the first intermediate frequency (f_{I1}) of the receiver; hence, the frequencies of these spurious responses are:

$$nf_{LO} \pm f_{I1}$$

where n is an integer greater than or equal to 2.

The measurement of the first image response of the receiver shall initially be made to verify the calculation of spurious response frequencies.

For the calculations a) and b) above, the manufacturer shall state the frequency of the receiver, the frequency of the local oscillator signal (f_{LO}) applied to the 1st mixer of the receiver, the intermediate frequencies (f_{I1} , f_{I2} etc.), and the switching range (sr) of the receiver.

Method of search over "limited frequency range"

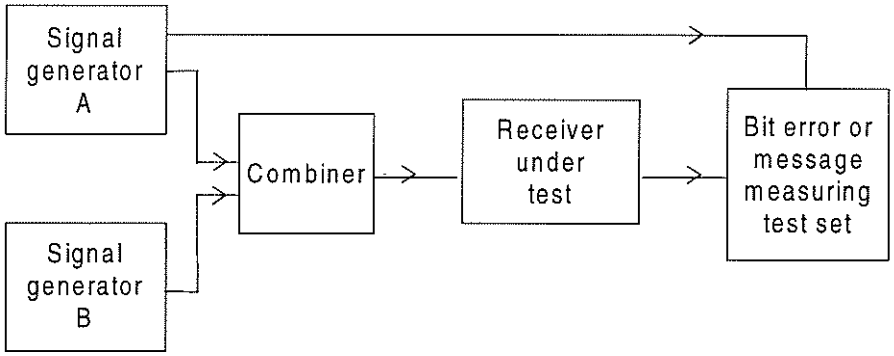


Figure 11 Measurement arrangement

The measurement procedure shall be as follows:

a) Two signal generators, A and B, shall be connected to the receiver via a combining network.

The wanted signal, provided by signal generator A, shall be at the nominal frequency of the receiver and shall have the normal test signal or modulation (see 10.4).

The unwanted signal, provided by signal generator B, shall be modulated with a 400 Hz signal with a deviation of 12 % of the channel separation.

b) Initially, signal generator B (unwanted signal) shall be switched off (maintaining the output impedance).

The level of the wanted signal from generator A shall be adjusted to the level which is 3 dB above the level of the limit of the maximum usable sensitivity as specified in 15.3.1, at the receiver input terminals (i.e. 6 dB above –113 dBm under normal test conditions).

In the case where a continuous bit stream is used, the bit error ratio of the receiver after demodulation shall be noted.

c) Signal generator B shall then be switched on, and the level of the unwanted signal adjusted to -27 dBm at the receiver input terminals.

The frequency of the unwanted signal generator shall be varied in increments of 5 kHz over the limited frequency range and over the frequencies in accordance with the calculations outside of this frequency range.

d) The frequency of any spurious response detected (e.g. by an increase in the previously noted bit error ratio) during the search shall be recorded for use in the measurements in accordance with the measure.

e) In the case where operation using a continuous bit stream is not possible a similar method shall be used. In such case, instead of identifying a spurious response by noting an increase in the bit error ratio, spurious responses shall be identified by a degradation of the successful message ratio.

Method of measurement with messages

The measurement shall be performed as follows, using the measurement arrangement of Figure 11:

a) Two signal generators, A and B, shall be connected to the receiver via a combining network.

The wanted signal, provided by signal generator A, shall be at the nominal frequency of the receiver and shall have normal test modulation (see 10.4).

The unwanted signal, provided by signal generator B, shall be modulated with a frequency of 400 Hz and with a deviation of 12 % of the channel separation and shall be at the frequency of that spurious response being considered.

b) Initially, signal generator B (unwanted signal) shall be switched off (maintaining the output impedance).

The level of the wanted signal from generator A shall be adjusted to the level which is 3 dB above the level of the limit of the maximum usable sensitivity as specified in subclause 15.3.1, at the receiver input terminals (i.e. 6 dB above –113 dBm under normal test conditions).

c) Signal generator B shall then be switched on, and the level of the unwanted signal adjusted until a successful message ratio of less than 10 % is obtained.

d) The normal test signal (subclause 10.4) shall then be transmitted repeatedly whilst observing in each case whether or not a message is successfully received.

The level of the unwanted signal shall be reduced by 2 dB for each occasion that a message is not successfully received.

The procedure shall be continued until three consecutive messages are successfully received. The level of the input signal shall then be noted.

e) The level of the unwanted signal shall be increased by 1 dB and the new value noted.

The normal test signal (see 10.4) shall then be transmitted 20 times. In each case, if a message is not successfully received the level of the unwanted signal shall be reduced by 1 dB and the new value noted.

If a message is successfully received, the level of the unwanted signal shall not be changed until three consecutive messages have been successfully received. In this case the unwanted signal shall be increased by 1 dB and the new value noted.

No level of the unwanted signal shall be noted unless preceded by a change in level.

The average of the values noted in steps d) and e) (which provides the level corresponding to the successful message ratio of 80 % shall be noted.

f) For each frequency, the spurious response rejection shall be expressed as the ratio, in dB, of the level of the unwanted signal to the level of the wanted signal, at the receiver input. This ratio shall be recorded.

g) The measurement shall be repeated at all spurious response frequencies found during the search over the limited frequency range, and at frequencies calculated for the remainder

of the spurious response frequencies in the frequency range from f_{Rx} / 3,2 or 30 MHz, whichever is higher, to 3,2 × f_{Rx} , where f_{Rx} is the nominal frequency of the receiver.

h) The spurious response rejection of the equipment under test shall be expressed as the lowest value recorded in step f.

Required results

At any frequency separated from the nominal frequency of the receiver by two channels or more, the spurious response rejection shall not be less than 70,0 dB.

15.3.9 (7.2) Intermodulation response rejection and Blocking

Definition

The intermodulation response rejection is the capability of the receiver to receive a wanted modulated signal, without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency.

Method of test

Four signal generators shall be connected to the AIS transponder under test (see Figure 12). The wanted signals, represented by signal generator A, shall be set up in accordance with the packet error rate measurement (see paragraph 15.3.3) to the TDMA AIS test in accordance with table 5. The wanted signal levels at the RF input of the AIS transponder shall be set to -101 dBm.

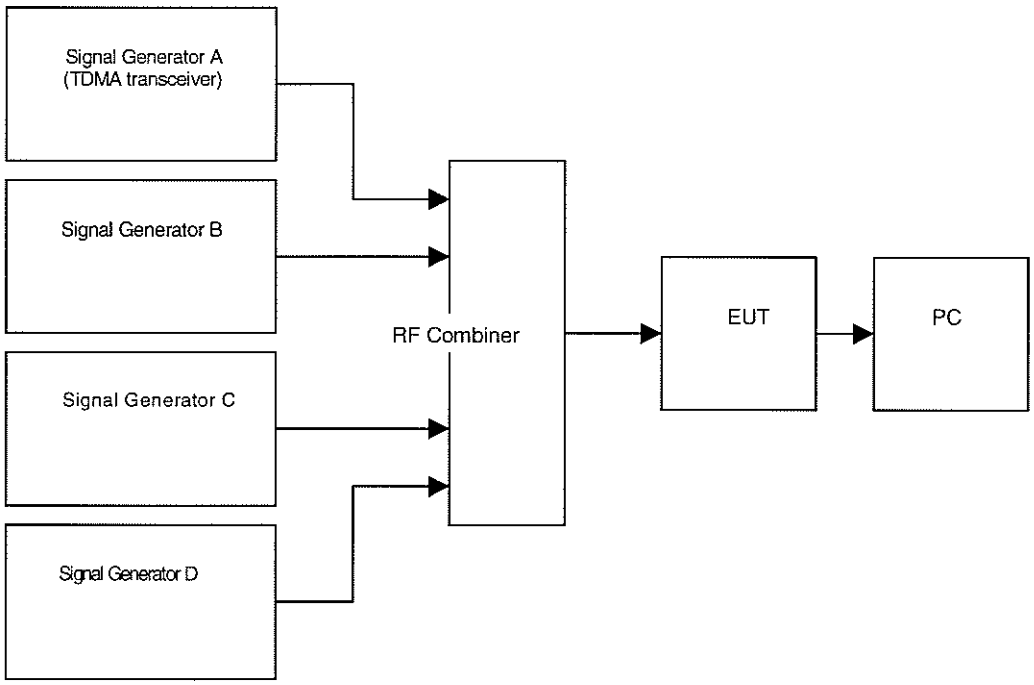


Figure 12 Test set-up

The unwanted signal from signal generator B shall be modulated by 400Hz with a deviation of +/-3 kHz and adjusted to a frequency 500 kHz above or below the frequency of the AIS1 channel. The unwanted signal from signal generator C shall be unmodulated and adjusted to a frequency 1000 kHz above or below the frequency of the AIS channel. The unwanted signal levels from signal generators B and C at the RF input of the AIS transponder shall be set to –27 dBm.

The unwanted signal from signal generator D shall be unmodulated and adjusted to a frequency 5.725 MHz above or below the frequency of the AIS channel. The unwanted signal level from signal generator D at the RF input of the AIS transponder shall be set to –15 dBm.

Table 17

	Generator A	Generator B	Generator C	Generator D
Test #1	156.025	156.525	157.025	161.750
Test #2	162. 025	161.525	161.025	156.300

Required results

The packet error rate, with the outputs of signal generators B, C, and D switched on, shall be 20% or less.

15.3.10 (ITU-R M.1371 A2/2.12.4) Transmit to receive switching time

Definition

The transmit to receive switching time describes the capability of the TDMA receiver to receive in the slot immediately following the transmission slot.

Method of measurement

Configure the measurement in accordance with Figure 11, but add a 30 dB power attenuator between the receiver under test and the signal generator from the TDMA transmitter in the unit under test. Set the TDMA transmitter in the unit under test to transmit at the default power setting (nominal 12.5 Watts) in the slot immediately preceding the slot used for performing the receiver sensitivity measurement specified in 15.3.1.

Required results

The sensitivity shall be –107 dBm with a PER of at most 20% under normal test conditions.

15.4 (M.1371 A3) DSC Receiver

15.4.1 Maximum Sensitivity

Definition

The maximum sensitivity of the receiver is the minimum level of the signal dBm at the nominal frequency of the receiver which when applied to the receiver input with a test modulation will produce a bit error rate of 10^{-2}.

Method of measurement

The test equipment shall be set to transmit continuous DSC dot pattern as the test modulation of the RF signal generator connected to the EUT. The EUT shall provide a logic level test output from its internal DSC demodulator to measure bit error rate.

Required result

The maximum usable sensitivity shall not exceed –107 dBm under normal test conditions, and –101 dBm under extreme test conditions. The test shall be repeated at the nominal carrier frequency (156,525 MHz) +/- 1,5 kHz.

15.4.2 (M.1371 A3) Error Behaviour at High Input Levels

Definition

The dynamic range of the equipment is the range from the minimum to the maximum level of a radio frequency input signal at which the bit error rate in the output of the receiver does not exceed a specified value.

Method of measurement

A test signal, in accordance with standard test signal number 1, shall be applied to the receiver input. The level of the test signal shall be –7dBm.

Required result

The BER shall not exceed 10^{-2}.

15.4.3 (M.1371 A3) Co-Channel Rejection

Definition

The co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal, both signals being at nominal frequency of the receiver.

Method of measurement

The wanted signal shall be standard test signal number 2. The level of the wanted signal shall be -104 dBm.

The unwanted signal shall be modulated by 400 Hz with a deviation of ±3 kHz. The input level of the unwanted signal shall be –112 dBm.

Both input signals shall be at the nominal frequency of the receiver under test and the measurement shall be repeated for displacements of the unwanted signal of up to ±3 kHz.

Required result

The value of the co-channel rejection ratio, expressed in dB, at the signal displacements given in the method of measurement, shall be between - 10,0 dB and 0 dB.

15.4.4 (M.1371 A3) Adjacent Channel selectivity

Definition

The adjacent channel selectivity characterises the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal that differs in frequency from the wanted signal by 25 kHz.

Method of measurement

The wanted signal shall be standard test signal number 1. The level of the wanted signal shall be -104 dBm.

The unwanted signal shall be modulated by 400 Hz with a deviation of ±3 kHz. The input level of the unwanted signal shall be –34 dBm. The unwanted signal shall be tuned to the centre frequency of the upper adjacent channels.

The measurement shall be repeated with the unwanted signal tuned to the centre frequency of the lower adjacent channel.

Required result

The adjacent channel selectivity for different channel separations shall not be less than the values given in Table 18.

Table 18 Adjacent channel selectivity DSC

Normal test conditions	70,0 dB
Extreme test conditions	60,0 dB

15.4.5 (M.1371 A3) Spurious Response Rejection

Definition

The spurious response characterises the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal with frequencies outside the band of the receiver.

Method of measurement

The wanted signal shall be standard test signal number 1. The level of the wanted signal shall be -104 dBm.

The unwanted signal shall be unmodulated. The frequency shall be varied between 100 kHz and 2 GHz. The level of the unwanted signal shall be –24 dBm.

Required result

At any frequency separated from the nominal frequency of the receiver by two channels or more, the spurious response rejection shall not be less than 70,0 dB.

15.4.6 (M.1371 A3) Intermodulation response Rejection

Definition

The inter-modulation response ratio characterises the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency.

Method of measurement

The wanted signal represented by signal generator A shall be at the nominal frequency of the receiver and shall be standard test signal number 1. The level of the wanted signal shall be –104 dBm.

The unwanted signal from signal generator B shall be unmodulated and adjusted to a frequency 50 kHz above the nominal frequency of the receiver. The second unwanted signal from signal generator C shall be modulated by 400 Hz with a deviation of ±3 kHz and adjusted to a frequency 100 kHz above the nominal frequency of the receiver. The input level of each unwanted signal shall be –39 dBm. The test shall be repeated with the frequency of the unwanted signals below the nominal frequency of the receiver.

Required result

The intermodulation response rejection ratio shall not be less 65,0 dB.

15.4.7 (M.1371 A3) Blocking or Desensitisation

Definition

The blocking immunity characterises the capability of the receiver to receive a wanted modulated signal without exceeding a given degradation due to the presence of an unwanted modulated signal with frequencies outside the band of the receiver.

Method of measurement

The wanted signal shall be standard test signal number 2. The level of the wanted signal shall be -104 dBm.

The unwanted signal shall be unmodulated. The frequency shall be varied between –10 MHz and -1 MHz and also between +1 MHz and +10 MHz relative to the nominal frequency of the wanted signal. The level of the unwanted signal shall be –20 dBm.

Required result

The blocking ratio for any frequency within the specified ranges shall not be less than 84,0 dB, except at frequencies on which spurious responses are found.

15.5 Conducted Spurious Emissions conveyed to the antenna

15.5.1 (ITU-R M.489-2) Spurious Emissions from the Receiver

Definition

Conducted spurious emissions to the antenna are any RF emissions generated in the receiver and conveyed to the antenna terminal.

Method of Measurement

Conducted spurious emissions shall be measured as the power level of any frequency component to the antenna terminals of the receiver. The receiver antenna terminals are conducted to a spectrum analyser or selective voltmeter having an input impedance of 50 ohms and the receiver is switched on.

If the detecting device is not calibrated in terms of power input, the level of any detected components shall be determined by a substitution method using a signal generator. The measurement shall extend over the frequency range 150 kHz to 2 GHz.

Results Required

The power of any spurious emission in the specified range at the antenna terminal shall not exceed –57 dBm (2 nW) in the frequency range 150 kHz to 1 GHz and –37 dBm (20 nW) in the frequency range 1 GHz to 2 GHz.

15.5.2 (ITU-R M.489-2) Spurious Emissions From the Transmitter

Definition

Conducted spurious emissions are emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic missions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

Method of Measurement

Conducted spurious emissions shall be measured with the unmodulated transmitter connected to the artificial antenna. The measurement shall be made over a frequency range from 150 kHz to 2 GHz, excluding the channel on which the transmitter is operating and its adjacent channels.

Results Required

The power of any spurious emission on any discrete frequency shall not exceed 0,25 uW in the frequency range 150 kHz to 1 GHz and 1 uW in the frequency range 1 GHz to 2 GHz

16 (7.3) Specific tests of Link Layer

16.1 (M.1371 A1/3.1.1) TDMA Synchronisation

16.1.1 (M.1371 A1/3.1.3.4.1) Synchronisation test using UTC

Method of measurement

Set up standard test environment; chose test conditions in a way that the EUT operates in following synchronisation modes:

- UTC direct
- UTC indirect (internal GNSS receiver disabled; at least one other station UTC direct synchronised)
- BASE direct (internal GNSS disabled; base station with UTC direct synchronisation within range)

Check CommState Parameter SyncState in position Report and reporting rate

Required result

Transmitted Communication state shall fit the Synchronisation mode

16.1.2 (M.1371 A1/3.1.1.4) Synchronisation test without UTC, semaphore

Method of measurement

Set up standard test environment without UTC available. Let EUT operate as a sync source (semaphore) for other stations. Check CommState Parameter SyncState in position Report and reporting rate.

Required results

Transmitted CommState shall fit the Synchronisation mode.

The EUT shall increase reporting rate to 2 s when acting as a semaphore.

16.1.3 (M.1371 A1/3.1.1) Synchronisation test without UTC

Method of measurement

Set up standard test environment; chose test conditions in a way that EUT operates in following sync modes:

a) BASE indirect (internal GNSS disabled; no station with UTC direct synchronisation or Base station within range,)

b) mobile direct (internal GNSS disabled; no station with UTC direct synchronisation or Base station within range,)

c) Enable internal GNSS in synchronisation modes other than UTC direct

Check CommState Parameter SyncState in position Report and reporting rate.

Required results

a) Transmitted Communication state shall fit the Synchronisation mod

b) Transmitted Communication state shall fit the Synchronisation mod

c) Synchronisation mode shall revert to UTC direct

16.2 (M.1371 A1/3.1.2) Time division (Frame format)

Method of measurement

Set the EUT to max reporting rate of 2 sec by applying a speed of >23kn and a ROT of >20°/sec. Record VDL messages and check for used slots. Check parameter slot number in CommState of position report. Check slot length (transmission time)

Required results

Slot number used and slot number indicated in CommState shall match. Slot number shall not exceed 2249. Slot length shall not exceed 26,67msec.

16.3 (M.1371 A1/3.2.2.8.4) Synchronisation jitter

Definition

Synchronisation jitter (transmission timing error) is the time between nominal slot start as determined by the UTC synchronisation source and the initiation of the "transmitter on" function (T_o see figure 3.2.2.10 in Rec. ITU-R M.1371-1).

Method of measurement

Set-up standard test environment. Set the EUT to 25 kHz bandwidth, max reporting rate of 2 sec and using

a) UTC direct synchronisation

b) UTC indirect synchronisation by disconnecting the GNSS antenna of the EUT.

Record VDL messages and measure the time between the nominal beginning of the slot interval and the initiation of the "transmitter on" function. Alternative methods, e.g. by evaluating the start flag and calculating back to T_o are allowed.

Repeat the test for 12.5 kHz bandwidth.

Required results

The synchronisation jitter shall not exceed

a) ±104 µs using UTC direct synchronisation

b) ±312 µs using UTC indirect synchronisation .

16.4 Data encoding (bit stuffing)

Method of measurement

Setup standard test environment.

- apply a binary broadcast message (msg 8) to the VDL containing the HEX-values “7E 3B 3C 3E 7E” in the data portion and check Presentation Interface output of EUT
- apply a BBM message to the EUT initiating the transmission of msg 8 containing the HEX-values as above in the data portion and check the VDL

Required results

Confirm that

- Data output on the presentation interface conforms to transmitted data
- transmitted VDL message conforms to data input on the Presentation Interface

16.5 (M.1371 A1/3.2.3) Frame check sequence

Method of measurement

Apply a simulated position report message with wrong CRC bit sequence to the VDL.

Required results

Confirm that this message is not forwarded to the PI by the EUT.

16.6 (M.1371 A1/3.3.1) Slot allocation (Channel access protocols)

16.6.1 Network entry

Method of measurement

Set up standard test environment; switch on EUT. Record transmitted scheduled position reports for the first 3 frames after initialisation period. Check CommState for channel access mode

Required results

EUT shall start autonomous transmissions of msg 3 (position report) with ITDMA CommState with KeepFlag set true for first frame and msg 1 with SOTDMA CommState for consecutive frames.

16.6.2 (M.1371 A1/3.3.2) Autonomous scheduled transmissions (SOTDMA)

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Record transmitted scheduled position reports msg 1 and check frame structure. Check CommState of transmitted messages for channel access mode and parameters slot timeout, slot number and slot offset

Required results

Check that nominal reporting rate is achieved ±20% (allocating slots in selection interval SI). Confirm that the EUT allocates new slots NTS within SI after 3 to 8min. Check that slot offset indicated in CommState matches slots used for transmission.

16.6.3 (M.1371 A1/3.3.2) Single message transmission (RATDMA)

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Apply a 1 slot Binary Broadcast message (msg 8) to the PI of the EUT. Record transmitted messages.

Required results

Confirm that EUT transmits this msg 8 within max. 4sec. Retry with 90% channel load.

16.6.4 (M.1371 A1/3.3.6) Assigned operation

16.6.4.1 Receiving test

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Transmit an Assigned mode command (msg 16) to the EUT with:

- slot offset and increment
- designated reporting rate.

Record transmitted messages.

Required results

Confirm that EUT transmits position report msg 2 according to defined parameters and reverts to SOTDMA msg 1 with standard reporting rate after 4 to 8 min (ITU-R M.1371 A2/3.3.8.2.12).

16.6.4.2 (M.1371 A1/3.3.6) Assignment selectivity

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. check frame structure. Transmit an Assigned mode command (msg 16) to another AIS with a slot offset and increment pointing to a slot used by the EUT. Record transmitted messages.

Required results

Confirm that EUT does not use slots allocated to other stations.

16.6.5 (M.1371 A1/3.3.6) Fixed allocated transmissions (FATDMA)

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Transmit a Data Link Management message (msg 20) to the EUT with slot offset and increment. Record transmitted messages.

Required results

Confirm that EUT does not use slots allocated by msg 20 for own transmissions until timeout of 4 to 8 min.

16.7 (M.1371 A1/3.3.7) Message Formats

16.7.1 Received messages

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Apply messages according to Table 6to the VDL. Record messages output by the PI of EUT.

Required results

Confirm that EUT outputs corresponding message with correct field contents and format via the PI or responds as appropriate.

16.7.2 (M.1371 A1/3.3.7) Transmitted messages

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Initiate the transmission of messages relevant for a mobile station according to Table 6 by the EUT. Record transmitted messages.

Required results

Confirm that EUT transmits messages with correct field contents and format or responses as appropriate. Confirm that messages 4, 9,16, 17, 18, 19, 20, 21, 22 are NOT being transmitted by the EUT.

17 (7.4) Specific tests of Network Layer

17.1 (M.1371 A1/4.1) Dual channel operation

17.1.1 Alternate transmissions

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode on default channels AIS1, AIS2. Record transmitted scheduled position reports on both channels. Check CommState for slot allocation.

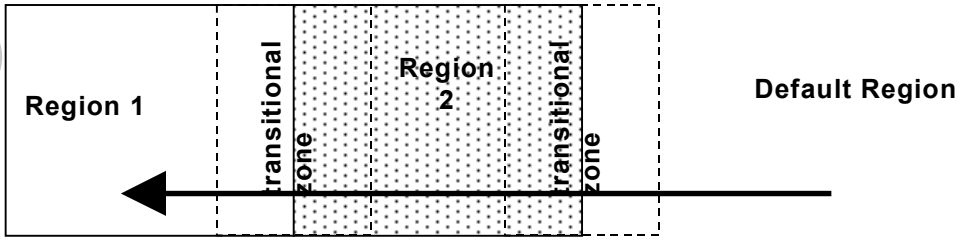
Required results

Confirm that EUT allocates slots in both channels alternating. Repeat check for data link access period.

17.2 (M.1371 A1/4.1)) regional area designation by VDL message

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Apply Channel management messages (msg 22) to the VDL defining two adjacent regional areas 1 and 2 with different channel assignments for both regions and a transitional zone extending 4nm either side of the regional boundary. At least one channel shall be 12.5kHz channel. Let the EUT approach region 1 from outside region 2 more than 5nm away from region boundary transmitting on default channels. Record transmitted messages on all 6 channels.



	primary channel	secondary channel
region 1	**CH A 1**	**CH B 1**
region 2	**CH A 2**	**CH B 2**
default region	**AIS 1**	**AIS 2**

Figure 13 Regional area scenario

Required results

Check that the EUT transmits and receives on the primary channels assigned for each region alternating channels and doubling reporting rate when passing through the transitional zones. EUT shall revert to default autonomous operation on the regional channels after leaving the transitional zones.

	Area	Channels in use
1	default region	AIS1, AIS2
2	first transitional zone	AIS1, CH A 2
3	region 2	CH A 2, CH B 2
4	second transitional zone	CH A 2, CH A 1
5	region 1	CH A 1, CH B 1

17.3 (M.1371 A1/4.1.3) regional area designation by serial message

Repeat test 17.2 using ACA serial message for channel assignment.

17.4 Power setting

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Transmit channel management message (msg 22) defining output power high/low.

Repeat test using ACA and manual input.

Required result

Check that EUT sets output power as defined.

17.5 (M.1371 A1/4.1.8) Message priority handling

Method of measurement

Set-up standard test environment and operate test equipment with 90% channel load. Set the EUT to max reporting rate of 2 sec by applying a speed of >23kn and a ROT of >20°/sec. Record VDL messages and check for used slots. Initiate the transmission of two 5 slot messages (msg 12 and msg 8) by the EUT. Record transmitted messages on both channels.

Required results

Check that EUT transmits the messages in correct order according to their priority (ITU-R M.1371 A/3.3.8.1 table 13).

17.6 (M.1371 A1/4.4) Slot reuse (link congestion)

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Transmit a Data Link Management message (msg 20) to the EUT with slot offset and increment to allocate slots for a base station. Assure that at test receiver location the signal level received from EUT exceeds the signal level received from test transmitter. Record transmitted messages and check frame structure. Set up additional test targets to simulate a VDL load of >90% until slot reuse by EUT is observed.

Required results

Check that the nominal reporting rate for Position Report msg 1 is achieved ±10% (allocating slots in selection interval SI) under link congestion conditions. Confirm that the slot occupied by the most distant station (within selection interval) is used by the slot reuse algorithm. Check that a station is not subject to slot reuse more than once a frame. Check that slots allocated by a local base station are not subject to slot reuse.

18 (7.5) Specific tests of Transport Layer

18.1 (M.1371 A1/5.3.1) Addressed messages

18.1.1 (M.1371 A1/5.3) Transmission

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Set up a test target for scheduled transmissions on channel AIS1 only. Initiate the transmission of an addressed binary message (msg 6) by the EUT (test target as destination). Record transmitted messages on both channels.

Required results

Check that the EUT transmits msg 6 on channel AIS1. Repeat test for AIS2.

18.1.2 Acknowledgement

Method of measurement

Operate standard test environment and EUT in autonomous mode. Apply up to 4 addressed binary messages (msg 6; EUT as destination) to the VDL on Channel AIS 1. Record transmitted messages on both channels. Repeat with AIS2.

Required results

Confirm that EUT transmits a binary acknowledge message (msg 7) with the appropriate sequence numbers within 4 sec on the channel where the msg 6 was received. Confirm that EUT transmit the result with an appropriate message to PI.

18.1.3 (M.1371 A1/5.3.1)Transmission Retry

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Initiate the transmission of up to 4 addressed binary messages by the EUT which will not be acknowledged (i.e. destination not available). Record transmitted messages.

Required results

Confirm that EUT retries the transmission up to 3 times (configurable) for each addressed binary message. Confirm that the time between transmissions is 4 to 8 sec. Confirm that EUT transmit the overall result with an appropriate message to PI.

18.1.4 Acknowledgement of Addressed safety related messages

Repeat test under 18.1.2with addressed safety related message.

18.2 (M.1371 A1/5.3) Interrogation responses

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Apply an interrogation message (msg 15; EUT as destination) to the VDL according to message table 6.3.3.8.1 for responses with msg 5 and slot offset set to defined value on channel AIS 1. Record transmitted messages on both channels.

Required results

Check that EUT transmits the appropriate interrogation response message as requested on channel AIS1. Repeat test for AIS2.

18.3 (M.1371 A1/5.3) Other non periodic messages

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Initiate the transmission of 5 binary broadcast messages (msg 8) by the EUT. Record transmitted messages on both channels.

Required results

Check that EUT transmits the msg 8 messages on channels A and B alternating.

19 (7.6) Specific Presentation Interface Tests

19.1 General

The EUT (Equipment Under Test) including all necessary test equipment shall be set-up and checked that it is operational before testing commences.

The manufacturer shall provide sufficient technical documentation of the EUT and its interfaces in particular.

The following tests shall be carried out under "Normal" environmental conditions as defined in IEC 60945.

Where appropriate, tests against different clauses of this and other chapters may be carried out simultaneously.

19.2 (7.6.1) Check of the manufacturer's documentation

The following checks for formal consistency and compliance shall be made for all ports

- approved sentences against IEC 61162
- proprietary sentences against IEC 61162
- usage of fields as required for different functions including provided default values or settings

- transmission intervals against IEC 61162
- configuration of hardware and software if this is relevant to the interface performance and port selection

The following checks for compliance with IEC 61162

- output drive capability
- load on the line of inputs
- electrical isolation of input circuits

19.3 (7.6.1) Electrical test

Method of test

Input / Output Ports configured as IEC 61162-1 or IEC 61162-2 shall be tested according to the relevant standard with regard to minimum and maximum voltage and current at the input terminals.

Required results

The interfaces shall fulfil the requirements of the relevant standards.

19.4 (7.6.2) Test of input sensor interface performance

Method of measurement

Connect all inputs and outputs of the EUT as specified by the manufacturer and simulate VDL-messages using test system. Operate inputs with simulated sensor data that are both the relevant data and additional data with formatters not provided for the relevant input. Each sensor input shall be loaded with 70 to 80 percent of the interface's capacity. Record the VDL and output from the EUT's high speed port.

Required results

Verify that the output on the VDL and the presentation interface agree with simulated input and all output data is transmitted without loss or additional delay.

19.5 (7.6.2) Test of sensor input

Method of measurement

Set-up standard test environment and operate inputs with simulated sensor data. Record VDL output.

- simulate sensor information for position, speed, heading, ROT
- simulate invalid and unavailable data
- simulate route plan input and initiate a route interrogation

Required results

Verify that the recorded VDL message contents agree with the simulated sensor information.

19.6 (7.6.3) Test of high speed output

Method of measurement

Set-up standard test environment and simulate VDL-position reports using test system. Record output from the EUT high speed port (see 0 Table 10).

Required results

Verify that the recorded message contents agree with the simulated VDL contents (VDM) and own transmitted data (VDO) and in accordance with the sentence specifications of IEC 61162-1.

19.7 (7.6.3) High speed output Interface performance

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Increase the VDL load to >90%. Record transmitted messages and check PI output of EUT on port for "external Display" and ”auxiliary Display”.

Required results

Confirm that EUT outputs all received messages to the PI. Repeat test for port "auxiliary display".

19.8 (7.6.3) Test of high speed input

Method of measurement

Set-up standard test environment. Apply simulated input data, in accordance with the sentence specifications of IEC 61162-1 and 7.6.3.3 Table 9, to the EUT and record VDL output.

Required results

Verify that the VDL message contents agree with simulated input data.

20 (M.1371 A3) DSC functionality tests

20.1 (M.1371 A3/1) General

For the tests in this clause, set the EUT into autonomous mode using channels AIS1 and AIS2 with a reporting interval of 2 s (for method of measurement see also IEC 61993-1).

Check with a sequence of valid calls consisting of a test signal number 1, a geographic call from ITU-R M.493, a test signal number 1, an individual call from ITU-R M.493 and a test signal number 1 that the EUT correctly receives and processes the three tests calls and its correct AIS operation is not affected by the interleaved calls.

Check that the EUT does not respond to invalid calls - incorrect MMSI position outside addressed geographic area, different course, or ship’s type.

Send to the EUT a standard test signal number 1 but with symbol numbers 104 and 03 followed by values 01 and 120 (Activate alternate system with group number 1 and sequence number 120). Check that the EUT does not respond.

20.2 (M.1371 A3/5) Regional area designation

Perform the test specified in 17.2 using the following DSC command:

Send to the EUT a standard test signal number 1 but with symbol numbers appropriate to the geographical regions and channels specified in the test. Note the transition boundary is 5nm in this test.

20.3 (M.1371 A3/2) Scheduling

Check that the time sequence of the TDMA messages is not changed when the EUT transmits a DSC signal.

Send a valid geographical call to the EUT. Check that the response is transmitted after a random delay distributed over the range of 0 to 20 s and subject to the restrictions of ITU-R M.1371 A3/2.2..

Send a valid geographical call to the EUT followed by a signal consisting of dot pattern with a signal level of -107 dBm at the receiver input of 25 s duration. Check that the response is not transmitted until the dot pattern signal is terminated.

20.4 (M.1371 A3/3) Polling

Check that the EUT is capable of receiving, processing and automatically transmitting a response to the following calls from ITU-R M.825: 101 (command to duplex-channel), 102, 103, 108, 109, 111, 112, and 116. The sequence of calls consisting of test signals number 1 and valid geographic calls shall demonstrate the capability of the EUT to operate on single frequency channels as well as on two frequency channels.

Verify through this test, that ships maritime mobile service identify (MMSI), ship name, ships length and type of ship is programmed into the EUT.

Send a standard test signal number 1 with additional symbols number 109 and 116 and check that the reply messages 100, 119 and 120 are programmed automatically.

Check that when information is not available to respond to a command the transmitted response is followed by the symbol 126.

Send a standard test signal number 1 with additional symbol 101 followed by channel number 87. Repeat the test with channel number 88 and with symbol 104 and 00 followed by channel number 2087 and 2088. Check in all cases that the response is made on channel 70

Send a DSI sentence to ports 4 and 5 with an individual station address and with command sets 103 (report your position) and 111 (report ship name). Check that the EUT does not transmit a DSC message.

Set the RF output power of the EUT high / low using the appropriate DSC command. Check that the output power is set accordingly.

21 (9) Long Range functionality tests

21.1 (9.2) LR interrogation

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Apply a LR addressed interrogation message to the LR-interface port of EUT; Record LR output port. Set EUT to

- automatic response
- manual response

Required results

Check that EUT outputs a LR position report message

- automatically (and indicates action on display)
- after manual confirmation

21.2 (9.2) LR "all ships" interrogation

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Apply a LR "all ships" interrogation message to the LR-interface port of EUT defining a geographical area which contains own ships position; Record LR output port. Set EUT to:

- automatic response
- manual response.

Repeat check with own ship outside specified area

Required results

Check that EUT outputs a LR position report message

- automatically (and indicates action on display)
- after manual confirmation.

No response shall be output on the repeat check.

21.3 (9.2) Consecutive LR "all ships" interrogations

Method of measurement

Set-up standard test environment and operate EUT in autonomous mode. Set EUT to automatic mode. Apply 5 LR "all ships" interrogation messages to the LR-interface port of EUT defining a geographical area which contains own ships position;

Record LR output port. Set the control flag in the LRI message to

- 0 (reply on first interrogation only)
- 1 (reply on all applicable interrogations).

Required results

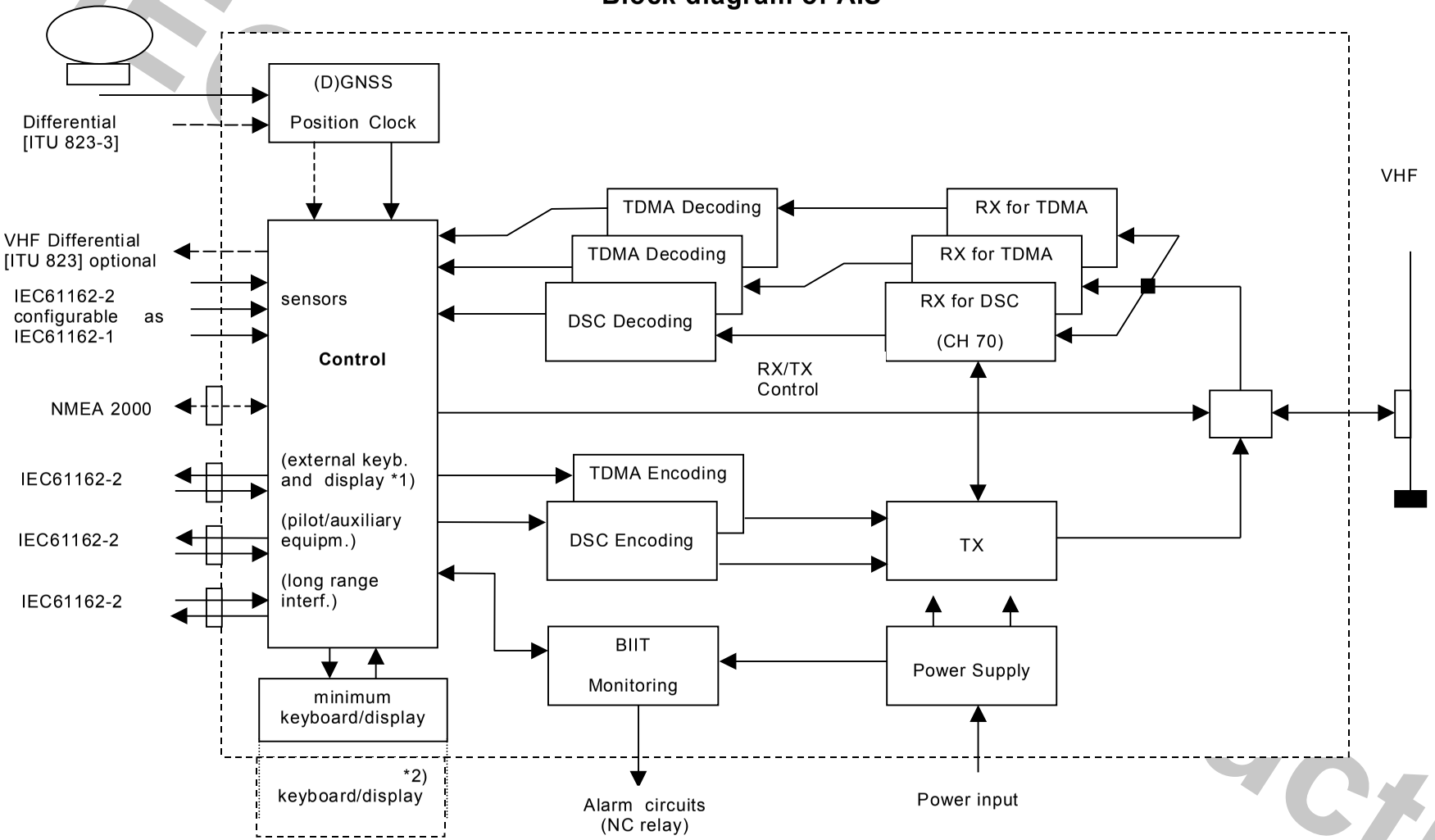
Check that EUT outputs a LR position report message

- on the first interrogation only
- on all interrogations.

_____

Annex A
(Informative)

Block diagram of AIS



*1) The external keyboard/display may be e.g. a radar, ECDIS or dedicated devices.
*2) The internal keyboard/display may optionally be remote.

Annex B
(Informative)

New messages of IEC 61162-1 due to AIS

(This informative annex will be removed after contents are published under IEC 61162-1)

B.1 Serial messages overview

B.1.1 Serial output messages related to received VDL messages

AIS target display information

1,2,3,9,18,21	position report
4	base station report
5	voyage related data
19	Class B - extended data

safety message handling

12	addressed safety related
14	broadcast safety related

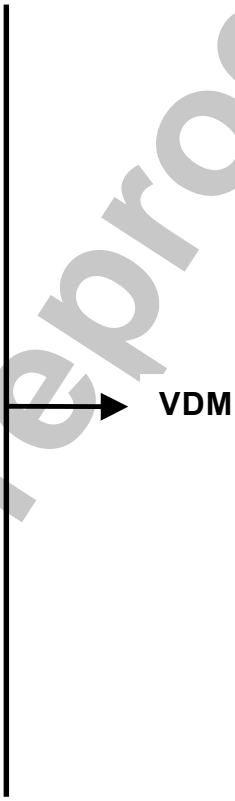
ext. Application handling

6	binary addressed
8	binary broadcast

System control

7	binary acknowledge (INFO)
13	safety related ack (INFO)
15	interrogation (INFO)
22	channel management (INFO)

also 10, 11, 16, 17, and 20 (INFO)



B.1.2 Serial output messages related to broadcast VDL messages

VHF Data-link messages broadcast by shipborne AIS unit (1, 2, 3, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15)	**VDO**
Addressed binary acknowledgement	**ABK**

B.1.3 Serial output messages NOT directly related to VDL messages

Long Range response	**LR1, LR2, LR3**
alarm status	*ALR, TXT [existing]*

B.1.4 Serial input messages directly related to VDL messages

5	ship and voyage related data	**SSD, VSD**
6	addressed binary	**ABM**
8	broadcast binary	**BBM**
12	addressed safety related	**ABM**
14	broadcast safety related	**BBM**
15	AIS interrogation request	**AIR**

B.1.5 Serial input messages NOT directly related to VDL messages

channel assignment	**ACA**
AIS alarm ack.	ACK [existing]
Long Range interrogation	**LRI, LRF**

B.2 Proposed IEC 61162-1 AIS Sentences

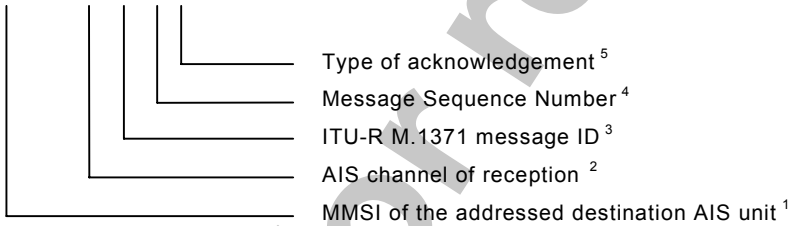
B.2.1 ABK - Addressed and binary broadcast acknowledgement

The ABK-sentence is generated when a transaction, initiated by reception of an ABM, AIR, or BBM sentence, is completed or terminated.

This sentence provides information about the success or failure of a requested ABM broadcast of either ITU-R M.1371 messages 6 or 12. The ABK process utilizes the information received in ITU-R M.1371 messages 7 and 13. Upon reception of either a VHF Data-link message 7 or 13, or the failure of messages 6 or 12, the AIS unit delivers the ABK sentence to the external application.

This sentence is also used to report to the external application the AIS unit's handling of the AIR (ITU-R M.1371 message 15) and BBM (ITU-R M.1371 messages 8 and 14) sentences. The external application initiates an interrogation through the use of the AIR-sentence, or a broadcast through the use of the BBM sentence. The AIS unit generates an ABK sentence to report the outcome of the AIR or BBM broadcast process.

\$--ABK,xxxxxxxxx,a,x.x,x,x*hh<CR><LF>



NOTE 1 Identifies the distant addressed AIS unit involved with the acknowledgement. If more than one MMSI are being addressed (ITU-R M.1371 message 15), the MMSI of the first distant AIS unit, identified in the message, is the MMSI reported here. When the Message ID is a general broadcast (ITU-R M.1371 messages 8 or 14), this field is null.

NOTE 2 Indication of VDL channel upon which Message ID 7 or 13 acknowledgement was received. An "A" indicates reception on channel A. A "B" indicates reception on channel B. If not available, field is null.

NOTE 3 This indicates to the external application the type of ITU-R M.1371 message that this ABK sentence is addressing. Also see the message IDs listed in NOTE 4.

NOTE 4 The message sequence number, together with the ITU-R M.1371 message ID and MMSI of the addressed AIS unit, uniquely identifies a previously received ABM, AIR, or BBM sentence. Generation of an ABK-sentence makes a sequential message identifier available for reuse. The ITU-R M.1371 Message ID is used to determine the origin of the message sequence identifier number. The following table lists the origins by message ID:

ITU-R M.1371 Message ID	Message Sequence Number source
6	sequential message identifier from ABM-sentence, IEC 61162-1
7	addressed AIS unit's message 7, sequence number, ITU-R M.1371
8	sequential message identifier from BBM-sentence, IEC 61162-1
12	sequential message identifier from ABM-sentence, IEC 61162-1
13	addressed AIS unit's message 13, sequence number, ITU-R M.1371
14	sequential message identifier from BBM-sentence, IEC 61162-1
15	no source, field shall be null

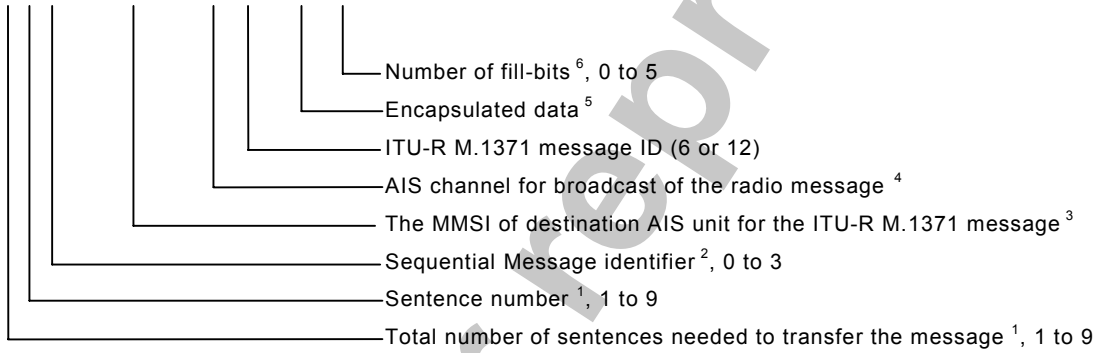
NOTE 5 Acknowledgements provided are:

0 = message (6 or 12) successfully received by the addressed AIS unit,
1 = message (6 or 12) was broadcast, but no acknowledgement by the distant addressed AIS unit,
2 = message could not be broadcast (i.e. quantity of encapsulated data exceeds five slots),
3 = requested broadcast of message (8, 14, or 15) has been successfully completed,
4 = late reception of a message 7 or 13 acknowledgement "addressed to own-ship" MMSI - identified by; destination MMSI, acknowledgement source MMSI, message sequence identifier, and message type. Late reception means that the AIS unit did not have an aacknowledgement process active for the acknowledgement that was received.

B.2.2 ABM - Addressed Binary and safety related Message

This sentence supports ITU-R M.1371 messages 6 and 12. It provides an external application with a means to exchange data using an AIS unit. The data is defined by the application only - not the AIS unit. This message offers great flexibility for implementing system functions that use the AIS unit like a communications device. After receiving this sentence, the AIS unit initiates a radio broadcast (on the VHF Data Link) of either message 6 or 12. The AIS unit will make up to four broadcasts of the message. The actual number will depend on the reception of an acknowledgement from the addressed "destination" AIS unit. The default time between retries is four seconds. Retries will not be attempted more frequently than 4 seconds. Retries end upon reception of the appropriate acknowledgement (see ITU-R M.1371 messages 7 and 13). The AIS unit will use up to 4 broadcasts, original broadcast plus three retires, to obtain an acknowledgement. This process could take 32 seconds to complete. The result of these broadcasts is provided by the ABK-sentence. The success or failure of reception of this broadcast by the intended AIS unit is confirmed through the use of the "Addressed and binary broadcast Acknowledgement (ABK)" sentence formatter, and the processes that support the generation of an ABK-sentence.

!--ABM,x,x,x,xxxxxxxxx,x,x.x,s--s,x*hh<CR><LF>



NOTE 1 The total number of sentences required to transfer the binary message data to the AIS unit. The first field specifies the total number of sentences used for a message, minimum value 1. The second field identifies the order of this sentence in the message, minimum value 1. All sentences contain the same number of fields. Successive sentences may use null fields for fields that have not changed, such as fields 4, 5, and 6.

NOTE 2 This sequential message identifier serves two purposes. It is both an IEC 61162-1 "sequential message identifier field," and it is the "sequence number" utilized by the ITU-R M.1371 in message types 6 and 12. The range of this field is restricted by ITU-R M.1371 to the range of 0 to 3. This sequential message identifier and the destination MMSI uniquely identifies a message. The sequential message identifier may be reused after the "ABK" acknowledgement for that sequence number is provided by the destination AIS unit. (see the ABK-sentence formatter)

NOTE 3 The MMSI of the AIS unit which is the destination of the message.

NOTE 4 The AIS channel that shall be used for the broadcast: 0 = no broadcast channel preference, 1 = Broadcast on AIS channel A, 2 = Broadcast on AIS channel B, 3 = Broadcast two copies of the message - one copy sent on channel A and another copy sent on channel B.

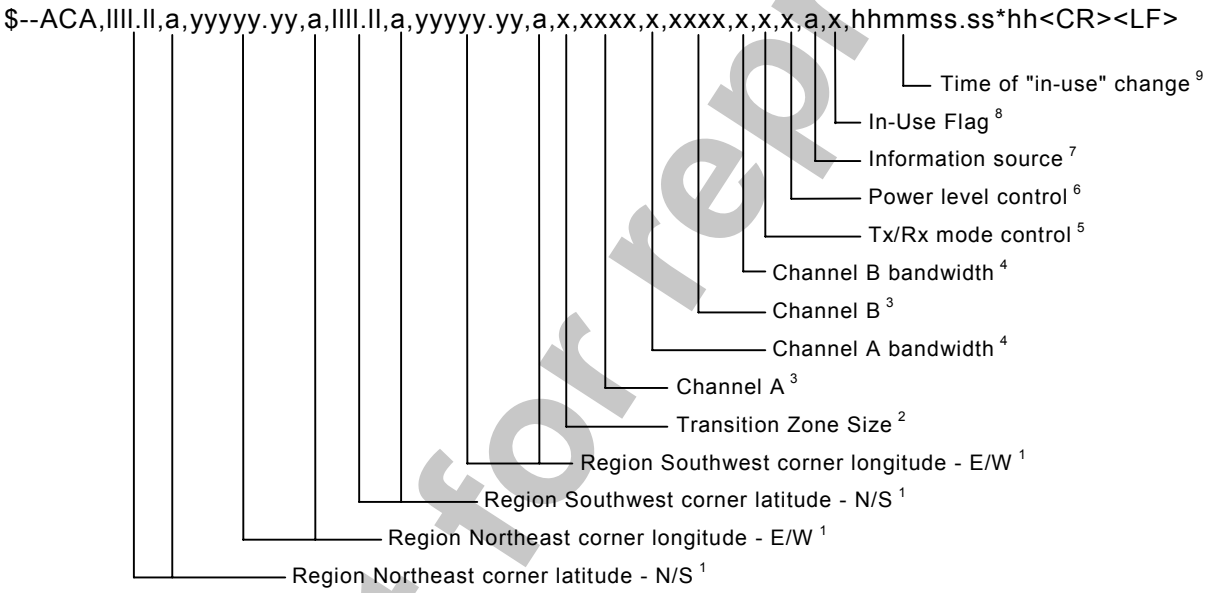
NOTE 5 This is the content of the "binary data" parameter for ITU-R M.1371 message 6, or the "Safety related Text" parameter for message 12. The first sentence may contain up to 48 "6-bit" symbols (288 bits). Following sentences may contain up to 60 valid "6-bit" symbols (360 bits), if fields 4, 5, and 6 are unchanged from the first sentence and set to null. The actual number of "6-bit" symbols in a sentence must be adjusted so that the total number of characters in a sentence does not exceed the "82-character" limit.

NOTE 6 To encapsulate, the number of binary bits must be a multiple of six. If it is not, one to five "fill bits" are added. This parameter indicates the number of bits that were added to the last 6-bit coded character. This value shall be set to zero when no "fill bits" have been added. This cannot be a null field.

B.2.3 ACA - AIS Regional Channel Assignment Message

An AIS unit can receive regional channel management information four ways: ITU-R M.1371 message 22, DSC telecommand received on channel 70, manual operator input, and an ACA-sentence. The AIS unit may store channel management information for future use. Channel management information is applied based upon the actual location of the AIS unit. An AIS unit is "using" channel management information when the information is being used to manage the operation of the VHF receivers and/or transmitter inside the AIS unit.

This sentence is used to both enter and obtain channel management information. When sent to an AIS unit, the ACA-sentence provides regional information that the unit stores and uses to manage the internal VHF radio. When sent from an AIS unit, the ACA-sentence provides the current channel management information retained by the AIS unit. The information contained in this sentence is similar to the information contained in an ITU-R M.1371 message 22. The information contained in this sentence directly relates to the "Initialization Phase" and "Dual Channel operation and Channel management" of the AIS unit as described in ITU-R M.1371.



NOTE 1 Geographic co-ordinates of the area to which the channel assignment applies.

NOTE 2 Value of 1 nautical mile to a value of 8 nautical miles (with a resolution of 1 nautical mile)

NOTE 3 VHF channel number, see ITU-R M.1084, Annex 4

NOTE 4 Value of 0, bandwidth is specified by channel number, see ITU-R M.1084, Annex 4
Value of 1, bandwidth is 12.5 kHz.

NOTE 5 Value of 0, transmit on channels A and B, receive on channels A and B
Value of 1, transmit on channel A, receive on channels A and B
Value of 2, transmit on channel B, receive on channels A and B
Value of 3, do not transmit, receive on channels A and B
Value of 4, do not transmit, receive on channel A
Value of 5, do not transmit, receive on channel B

NOTE 6 Value of 0, high power
Value of 1, low power

NOTE 7 Source identifiers:
A, ITU-R M.1371 message 22: Channel Management addressed message,
B, ITU-R M.1371 message 22: Channel Management broadcast geographical area message,
C, IEC 61162-1 AIS Channel Assignment sentence,
D, DSC Channel 70 telecommand, and
M, operator manual input.
This field should be null when the sentence is sent to an AIS unit.

NOTE 8 This value is set to indicate that the other parameters in the sentence are "in-use" by an AIS unit at the time that the AIS unit sends this sentence. A value of "0" indicates that the parameters are not "in-use," and a

value of "1" indicates that the parameters are "in-use." This field should be null when the sentence is sent to an AIS unit

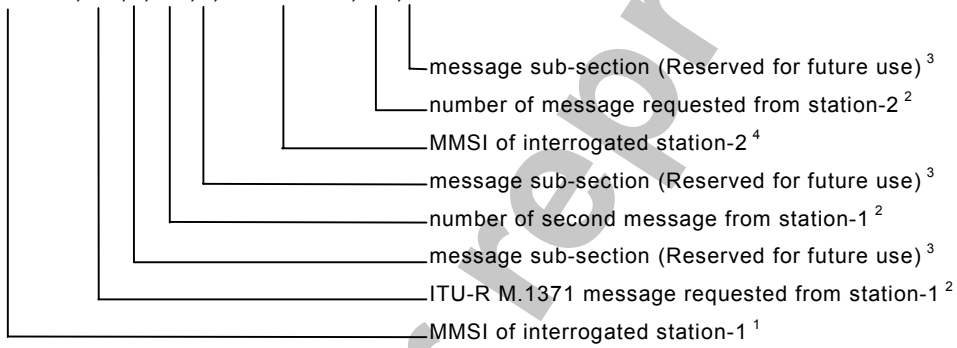
NOTE 9 This is the UTC time that the "in-use" flag changed to the indicated state. This field should be null when the sentence is sent to an AIS unit.

B.2.4 AIR - AIS Interrogation Request

This sentence supports ITU-R M.1371 message 15. It provides an external application with the means to initiate a request for specific ITU-R M.1371 messages from distant mobile or base station AIS units. A single sentence can be used to request up to two messages from one AIS unit and one message from a second AIS unit. The message types that can be requested are limited. The complete list of messages that can be requested can be found within the message 15 description in ITU-R M.1371. Improper requests may be ignored.

The external application initiates the interrogation. The external application is responsible for assessing the success or failure of the interrogation. After receiving this sentence, the AIS unit initiates a radio broadcast (on the VHF Data Link) of a message 15 - Interrogation. The success or failure of the interrogation broadcast is determined by the application by the combined reception of the ABK-sentence and future VDM-sentences provided by the AIS unit. After receiving this AIR-sentence, the AIS unit should take no more than four seconds to broadcast message 15, and the addressed distant unit(s) should take no more than another four seconds to respond - a total of eight seconds.

$--AIR,xxxxxxxxx,x.x,x,x.x,x,xxxxxxxxx,x.x,x*hh<CR><LF>



NOTE 1 Identifies the first distant AIS unit being interrogated. Two messages can be requested from the first AIS unit.

NOTE 2 Examples of messages that may be requested from a distant mobile AIS unit include:

Message 3, Position Report,
Message 5, Ship Static and Voyage related data,
Message 9, Standard SAR Aircraft Position Report,
Message 18, Standard Class B Equipment Position Report,
Message 19, Extended Class B Equipment Position Report, and
Message 21, Aids-to-Navigation Report.

Examples of messages that may be requested from a distant AIS base station include:
Message 4, Base Station Report,
Message 17, GNSS Broadcast Binary Message, (all available corrections are requested),
Message 20, Data Link Management Message,
Message 22, Channel Management.

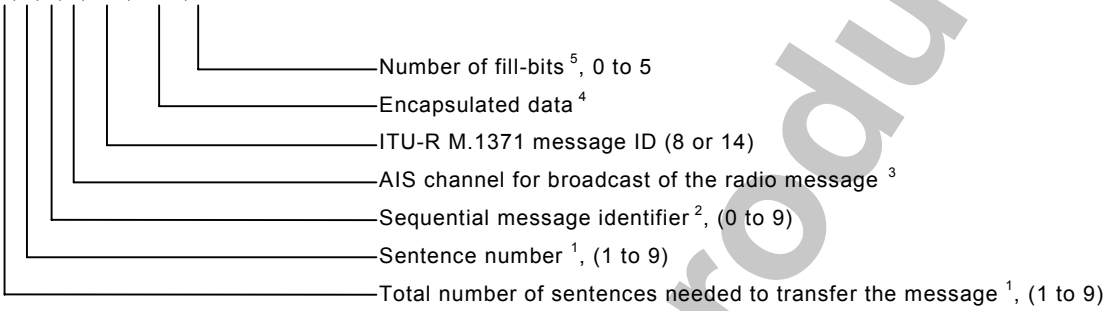
NOTE 3 This parameter is used to request a message that has been further sub-divided into alternative data structures. When requesting messages with alternative data structures, this message subsection identifier must be provided, so that the correct sub-division of the message data is provided. If the message structure is not sub-divided into different structures, this field should be null.

NOTE 4 This identifies the second distant AIS unit being interrogated. Only one message may be requested from the second AIS unit. The MMSI of the second AIS unit may be the same MMSI as the first AIS unit.

B.2.5 BBM - Broadcast Binary Message

This sentence supports generation of an ITU-R M.1371 Binary Broadcast Message (message 8) or Safety Related Broadcast Message (message 14). It provides an external application with a means to broadcast data, as defined by the application only - not the AIS unit. This message offers great flexibility for implementing system functions that use the AIS unit like a digital broadcast device. After receiving this sentence, the AIS unit initiates a VHF broadcast of either message 8 or 14 within four seconds. (Also, see the ABK-sentence.)

!--BBM,x,x,x,x,x.x,s--s,x*hh<CR><LF>



NOTE 1 The total number of IEC 61162-1 sentences needed to transfer the contents of the binary message to the AIS unit. The first field specifies the total number of sentences used for a message, minimum value 1. The second field identifies the order of this sentence in the message, minimum value 1. All sentences contain the same number of fields. Successive sentences may use null fields for fields that do not change - such as fields 4 and 5.

NOTE 2 The Sequential Message Identifier provides a message identification number from 0 to 9 that is sequentially assigned as needed. Note that this is only a sequential message identifier. This is used differently than the "Message sequence identifier" of an ABM sentence. This identifier is incremented for each new multi-sentence message. The count resets to 0, after 9 is used. For the contents of a message 8 or 14 requiring multiple sentences, each sentence of the message contains the same Sequential Message Identification number. This number is used to link the separate sentences containing portions of the same encapsulated data. This allows for the possibility that other sentences might be interleaved with the message sentences that, taken collectively, contain a single message 8 or 14. This number also links a future ABK-sentence acknowledgement to the appropriate BBM-sentence (See ABK, NOTE 4).

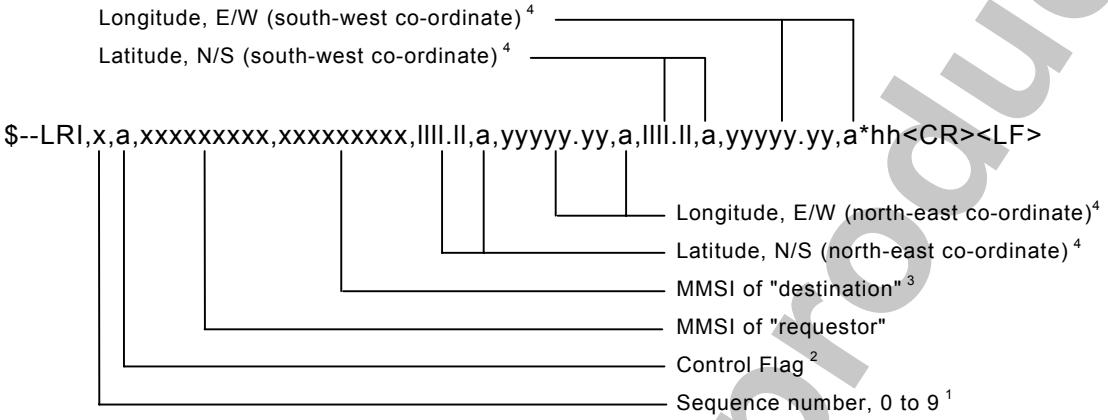
NOTE 3 The AIS channel that shall be used for the broadcast: 0 = no broadcast channel preference, 1 = Broadcast on AIS channel A, 2 = Broadcast on AIS channel B, 3 = Broadcast two copies of the message - one on channel A and another sent on channel B.

NOTE 4 This is the content of the "binary data" parameter for ITU-R M.1371 message 8 or the "Safety related Text" parameter for message 14. The first sentence may contain up to 58 "6-bit" symbols (348 bits). The following sentences may contain up to 60 "6-bit" symbols (360 bits), if fields 4 and 5 are unchanged from the first sentence and set to null. The actual number of "6-bit" symbols in a sentence must be adjusted so that the total number of characters in a sentence does not exceed the "82-character" limit.

NOTE 5 To encapsulate, the number of binary bits must be a multiple of six. If it is not, one to five "fill bits" are added. This parameter indicates the number of bits that were added to the last 6-bit coded character. This value shall be set to zero when no "fill bits" have been added. This cannot be a null field.

B.2.6 LRI - Long-Range Interrogation

The long-range interrogation of the AIS unit is accomplished through the use of two sentences. The pair of interrogation sentences, a LRI-sentence followed by a LRF-sentence, provides the information needed by a universal AIS unit to determine if it must construct and provide the reply sentences (LRF, LR1, LR2, and LR3). The LRI-sentence contains the information that the AIS unit needs in order to determine if the reply sentences need to be constructed. The LRF-sentence identifies the information that needs to be in the reply.



NOTE 1 This is used to bind the contents of the LRI and LRF sentences together. The LRF sentence shall immediately follow the LRI sentence and use the same sequence number. The requestor process shall increment the sequence number each time a LRI/LRF pair is created. After 9 is used, the process shall begin again from 0. The Long-range interrogation is not valid if the LRI and LRF sequence numbers are different.

NOTE 2 The control flag is a single character that qualifies the request for information. The control flag affects the AIS unit's reply logic. The control flag cannot be a null field. When the Control Flag is "0", the AIS unit responds if either:

The AIS unit is within the geographic rectangle provided, **and**
The AIS unit has not responded to the requesting MMSI in the last 24 hours, **and**
The MMSI "destination" field is null.

or

The AIS unit's MMSI appears in the MMSI "destination" field in the LRI sentence.

When the Control Flag is "1", the AIS unit responds if:

The AIS unit is within the geographic rectangle provided.

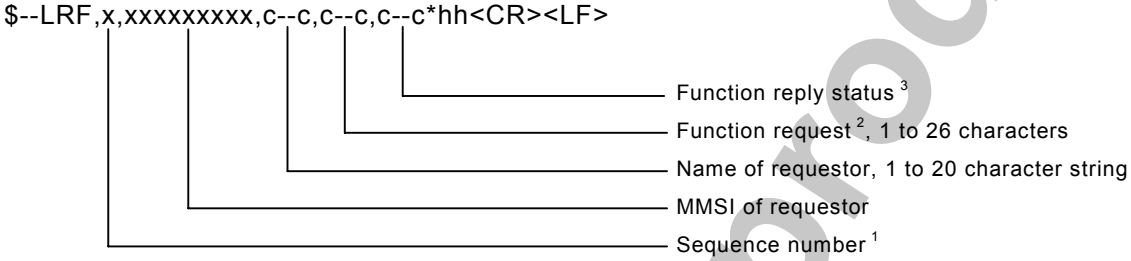
NOTE 3 This is the nine digit number that uniquely identifies the specific AIS unit that should respond. This field is a null field when the interrogation is for a geographic region. When addressing a specific AIS unit, it is not necessary to provide the geographic co-ordinates of the region.

NOTE 4 The geographic region is a rectangle defined by the latitude and longitude of the north-east and south-west corners. These fields should be null when interrogating a specific AIS unit (see note 2).

B.2.7 LRF – Long Range Function

This sentence is used in both long-range interrogation requests and long-range interrogation replies. The LRF-sentence is the second sentence of the long-range interrogation request pair, LRI and LRF (See the LRI-sentence).

The LRF-sentence is also the first sentence of the long-range interrogation reply. The minimum reply consists of a LRF-sentence followed by a LR1-sentence. The LR2-sentence and/or the LR3-sentence follow the LR1-sentence if information provided in these sentences was requested by the interrogation. When the AIS unit creates the LRF-sentence for the long-range interrogation reply, fields 1, 2, 3, and 4 should remain as received in the interrogation; and field 5 (Function Reply Status) and the new checksum are added to the LRF reply sentence.



NOTE 1 This is used to bind the contents of the LRI and LRF sentences together. The LRF sentence shall immediately follow the LRI sentence and use the same sequence number. The requestor process shall increment the sequence number each time a LRI/LRF pair is created. After 9 is used, the process shall begin again from 0. The Long-range interrogation is not valid if the LRI and LRF sequence numbers are different.

NOTE 2 The Function request field uses alphabetic characters based upon IMO Resolution A.851(20) to request specific information items. Specific information items are requested by including their function identification character in this string of characters. The order in which the characters appear in the string is not important. All characters are upper-case. Information items will not be provided if they are not specifically requested - even if available to the AIS unit. The IMO Resolution defines the use of all characters from A to Z, but not all of the defined information is available from the AIS unit. The following is a list of the function identification characters with the information they request:

A = Ship's: name, call sign, and IMO number

B = Date and time of message composition

C = Position

E = Course over ground

F = Speed over ground

I = Destination and Estimated Time of Arrival (ETA)

O = Draught

P = Ship / Cargo

U = Ship's: length, breadth, type

W = Persons on board

NOTE 3 The "Function Reply Status" field provides the status characters for the "Function Request" information. When a long-range interrogation request is originated, the "Function Reply Status" field should be null. The "Function Reply Status" characters are organized in the same order as the corresponding function identification characters in the "Function Request" field. The following is a list of the "Function Reply Status" characters with the status they represent:

2 = Information available and provided in the following LR1, LR2, or LR3 sentence,

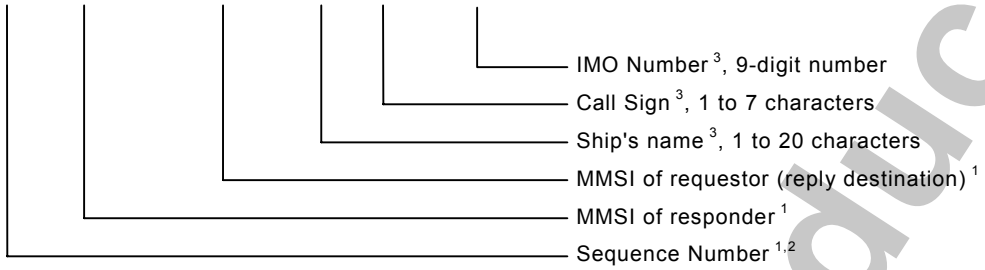
3 = Information not available from AIS unit,

4 = Information is available but not provided (i.e. restricted access determined by ship's master),

B.2.8 LR1 - Long-range Reply with destination for function request "A"

The LR1-sentence identifies the destination for the reply and contains the information requested by the "A" function identification character (See the LRF-sentence.).

$--LR1,x,xxxxxxxxx,xxxxxxxxx,c--c,c--c,xxxxxxxxx*hh<CR><LF>



NOTE 1 The three fields, sequence number, MMSI of responder, and MMSI of requestor are always provided.

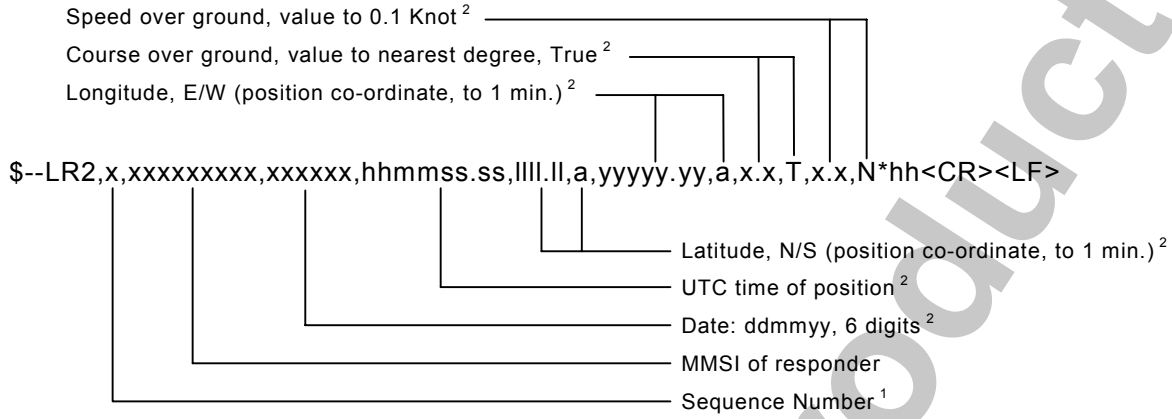
NOTE 2 The sequence number should be the same number as the sequence number of the LRI and LRF sentences that initiated this reply.

NOTE 3 The individual information items shall be a null field if any of the following three conditions exist:

The information item was not requested,
The information item was requested but is not available, or
The information item was requested but is not being provided.

B.2.9 LR2 - Long-range Reply for function requests "B, C, E, and F"

The LR2-sentence contains the information requested by the "B, C, E, and F" function identification characters (See the LRF-sentence.).



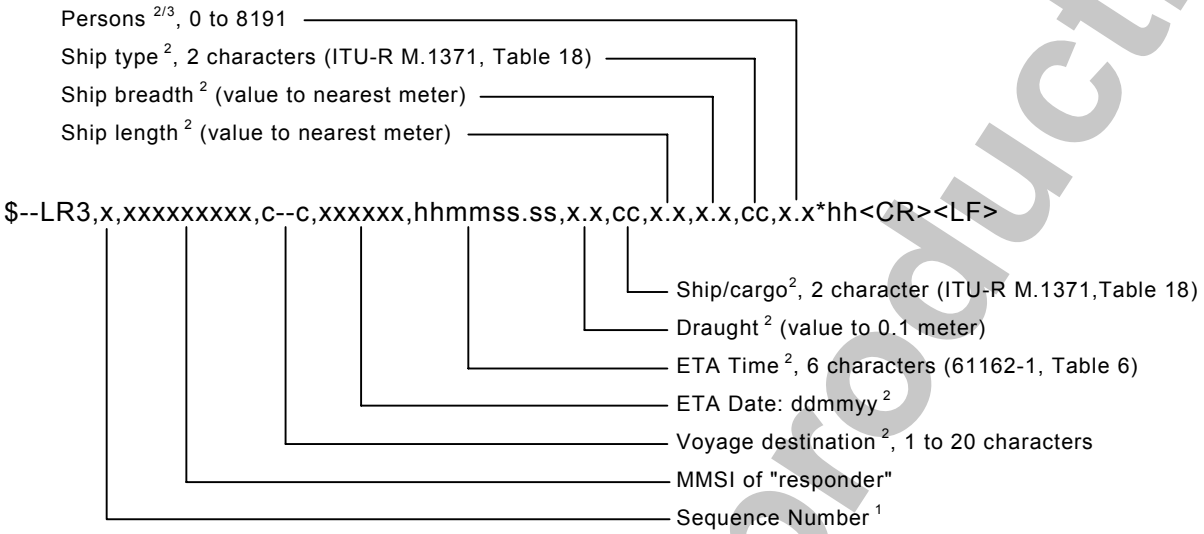
NOTE 1 The sequence number should be the same number as the sequence number of the LRI and LRF sentences that initiated this reply.

NOTE 2 The individual information items shall be a null field if any of the following three conditions exist:

The information item was not requested,
The information item was requested but is not available, or
The information item was requested but is not being provided.

B.2.10 LR3 - Long-range Reply for function requests "I, O, P, U and W"

The LR3-sentence contains the information requested by the "I, O, P, U, and W" function identification characters (See the LRF-sentence.).



NOTE 1 The sequence number should be the same number as the sequence number of the LRI and LRF sentences that initiated this reply.

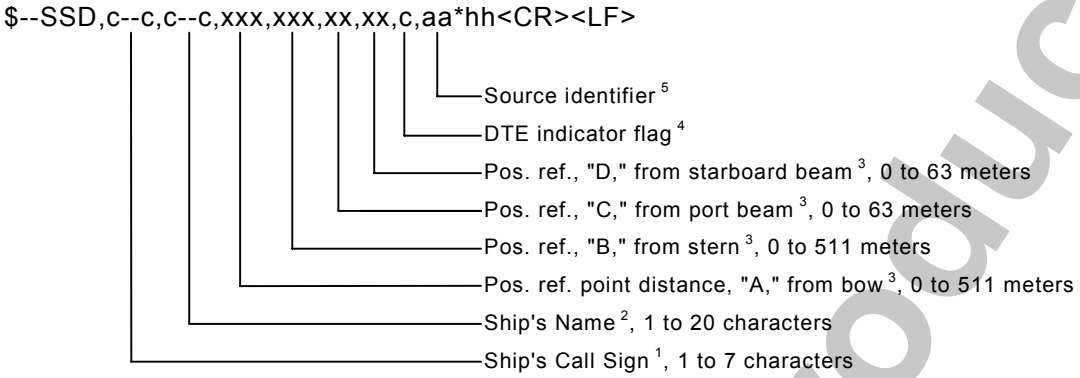
NOTE 2 The individual information items shall be a null field if any of the following three conditions exist:

The information item was not requested,
The information item was requested but is not available, or
The information item was requested but is not being provided.

NOTE 3 Current number of persons on-board, including crew members: 0 to 8191. 0 = default (not available), 8191 = 8191 or more people.

B.2.11 SSD - Ship Static Data

This sentence is used to enter static parameters into a shipboard AIS unit. The parameters in this sentence support a number of the ITU-R M.1371 messages.



NOTE 1 Ship call sign. A null field indicates that the previously entered call sign is unchanged. The string of characters "@@@@@@@" are used to indicate that the call sign is not available.

NOTE 2 The characters that can be used in the name are listed in the ITU-R M.1371, 6-bit ASCII table. Some of the acceptable characters in this 6-bit ASCII table are reserved characters under IEC 61162-1. They must be represented using the "^" method (see IEC 61162-1, section 5.1.3). A null field indicates that the previously entered name is unchanged. The string of characters "@@@@@@@@@@@@@@@@@@@@" are used to indicate that the ship's name is not available.

NOTE 3 These are the four dimensions from the bow, stern, port beam, and starboard beam to the horizontal reference point on the ship for which the current "position reports" are valid. The sum of A + B is the length of the ship in meters, and the sum of C + D is the width of the ship in meters. Refer to the ITU-R M.1371, message 5, "Reference Point for reported position and Dimensions of Ship." If the reference point of "reported position" is not available, but the dimensions of the ship are available: A = C = 0 and B > 0 and D > 0. If neither the reference point for the reported position nor the dimensions of the ship are available: A = B = C = D = 0 (default). Use of a null field for A, B, C, and/or D indicates that the previously entered dimension for that parameter is unchanged. In many cases, the ship's reference point for "reported position" will be the location of the positioning antenna.

NOTE 4 The DTE indicator is an abbreviation for Data Terminal Equipment indicator. The purpose of the DTE indicator is to inform distant receiving applications that, if set to "available," the transmitting station conforms, at least, to the minimum keyboard and display requirements. The DTE indicator is only used as information provided to the application layer - indicating that the transmitting station is available for communications. On the transmitting side, the DTE indicator may be set by an external application using this sentence. DTE indicator flag values are:

0 = Keyboard and display are a standard configuration, and communication is supported.

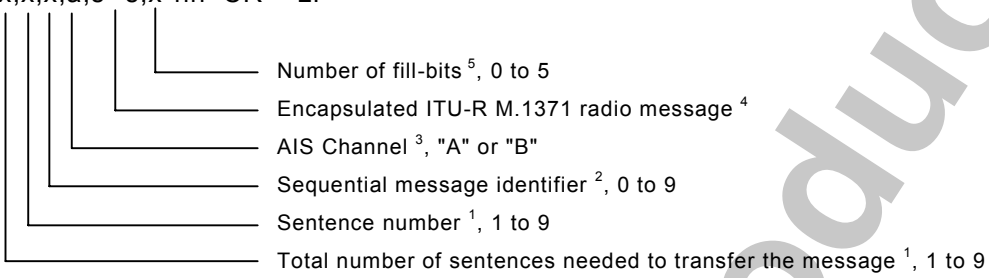
1 = Keyboard and display are either unknown or unable to support communication (default setting).

NOTE 5 The source identifier contains the "Talker ID" of the equipment at this location.

B.2.12 VDM - VHF Data-link Message

This sentence is used to transfer the entire contents of a received AIS message packet, as defined in ITU-R M.1371 and as received on the VHF Data Link (VDL), using the "6-bit" field type. The structure provides for the transfer of long binary messages by using multiple sentences.

!--VDM,x,x,x,a,s--s,x*hh<CR><LF>



NOTE 1 The length of an ITU-R M.1371 message may require the transmission of multiple sentences. The first field specifies the total number of sentences used for a message, minimum value 1. The second field identifies the order of this sentence in the message, minimum value 1. These cannot be null fields.

NOTE 2 The Sequential message identifier provides a message identification number from 0 to 9 that is sequentially assigned and is incremented for each new multi-sentence message. The count resets to 0 after 9 is used. For a message requiring multiple sentences, each sentence of the message contains the same sequential message identification number. It is used to identify the sentences containing portions of the same message. This allows for the possibility that other sentences might be interleaved with the message sentences that, taken collectively, contain a single message. This field shall be a null field when messages fit into one sentence.

NOTE 3 The AIS channel is indicated as either "A" or "B." This channel indication is relative to the operating conditions of the AIS unit when the packet is received. This field shall be null when the channel identification is not provided. The VHF channel numbers for channels "A" and "B" are obtained by using a "query" of the AIS unit for an ACA-sentence(s).

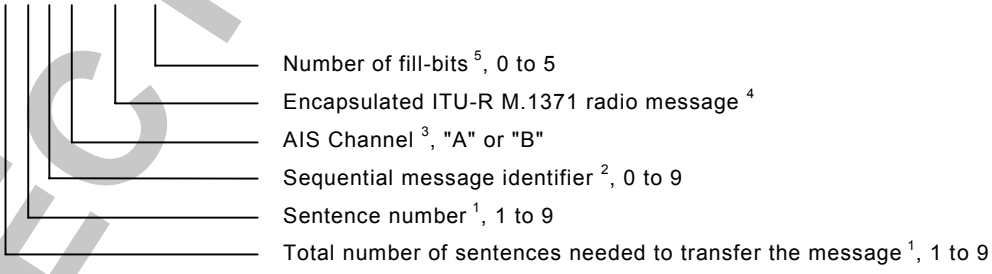
NOTE 4 The maximum string length of encapsulation is limited such that the total number of sentence characters does not exceed 82. This field supports a maximum of 62 valid characters for messages transferred using multiple sentences, and 63 valid characters for messages using a single sentence.

NOTE 5 To encapsulate, the number of binary bits must be a multiple of six. If it is not, one to five "fill bits" are added. This parameter indicates the number of bits that were added to the last 6-bit coded character. This value shall be set to zero when no "fill bits" have been added. This cannot be a null field.

B.2.13 VDO - VHF Data-link Own-vessel message

This sentence is used to transfer the entire contents of an AIS unit's broadcast message packet, as defined in ITU-R M.1371 and as sent out by the AIS unit over the VHF Data Link (VDL). It uses the 6-bit field type for encapsulation. The sentence uses the same structure as the VDM sentence formatter.

!--VDO,x,x,x,a,s--s,x*hh<CR><LF>

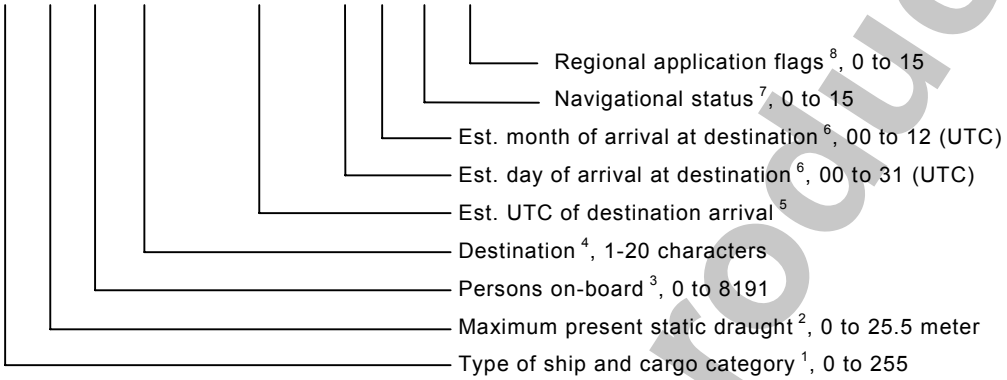


NOTES 1-5 See VDM-sentence notes.

B.2.14 VSD - Voyage Static Data

This sentence is used to enter information about a ship's transit that remains relatively static during the voyage. However, the information often changes from voyage to voyage. The parameters in this sentence support a number of the ITU-R M.1371 messages.

\$--VSD,x.x,x.x,x.x,c--c,hhmmss.ss,xx,xx,x.x,x.x*hh<CR><LF>



NOTE 1 Type of ship and cargo category are defined in ITU-R M.1371. The description of ship and cargo are indicated by a number. The values are defined in ITU-R M.1371, message 5. A null field indicates that this is unchanged.

NOTE 2 Draught is reported in the range of 0 to 25.5 meters. The value 0 = not available (default), and the value 25.5 indicates that the draught is 25.5 meters or more. Only values from 0 to 25.5 shall be accepted by the AIS unit. A null field indicates that this is unchanged.

NOTE 3 Number of persons on-board includes the crew. The value 0 = not available (default). The value 8191 = 8191 or more people. Only values from 0 to 8191 shall be accepted by the AIS unit. A null field indicates that this is unchanged.

NOTE 4 The characters that can be used in the destination are listed in the ITU-R M.1371, 6-bit ASCII table. Some of the acceptable characters in this 6-bit ASCII table are reserved characters under IEC 61162-1. They must be represented using the "^" method (see IEC 61162-1, section 5.1.3). A null field indicates that the previously entered destination is unchanged. The string of characters "@@@@@@@@@@@@@@@@@@@@" are used to indicate that the ship's destination is not available.

NOTE 5 The UTC time of arrival field follows the "TIME" field type described in Table 6 (IEC 61162-1). The two fixed digits of seconds are not broadcast by the AIS unit and can be set to "00". The optional decimal point and associated decimal fraction shall not be provided. The resulting time is a number with six fixed digits, "hhmm00". Leading zeros are always included for the hours and minutes. If the hour of arrival is not available, "hh" shall be set to 24. If the minute of arrival is not available, "mm" shall be set to 60. A null field indicates that this is unchanged.

NOTE 6 The day and month of arrival are in UTC. The day is a two-digit fixed number requiring leading zeros. The month is a two-digit fixed number requiring leading zeros. If the day of arrival is not available, "00" shall be the number for day. If the month of arrival is not available, "00" shall be the number for the month. A null field indicates that this is unchanged.

NOTE 7 The Navigational status is indicated using the following values, a null field indicates the status is unchanged (ref. ITU-R M.1371, Message 1, Navigational status parameter):

0 = under way using engine	5 = moored	10 = reserved for Wing In Ground
1 = at anchor	6 = aground	11 to 14 = reserved for future use
2 = not under command	7 = engaged in fishing	
3 = restricted manoeuvrability	8 = under way sailing	
4 = constrained by draught	9 = reserved for High Speed Craft	15 = not defined (default)

NOTE 8 Definition of values 1 to 15 provided by a competent regional authority. Value shall be set to zero (0), if not used for any regional application. Regional applications shall not use zero. A null field indicates that this is unchanged (ref. ITU-R M.1371, Message 1, Reserved for regional applications parameter).

B.3 VDM - VHF Data-link Message Encapsulation Example

B.3.1 Introduction

The IEC 61162-1 standard supports the transport of encapsulated binary coded data. In general, the proper decoding and interpretation of encapsulated binary data will require

access to information developed and maintained outside of the IEC 61162-1 standard. The IEC 61162-1 standard contains information that describes how the data should be coded, decoded, and structured. For AIS, the specific meaning of the binary data is obtained from the ITU-R M.1371 or this (IEC 61993-2) standard.

What follows is a practical example of how encapsulated binary coded data might be translated into meaningful information. The example is drawn from the operation of universal Automatic Identification System (AIS) equipment built to the ITU-R M.1371 recommendations. The sample sentence that will be used in this example is:

```
!AIVDM,1,1,,1,1P000Oh1IT1svTP2r:43grwb0Eq4,0*71<CR><LF>
```

Also included with this example are a worksheet, Figure G-2, and a copy of IEC 61162-1, Table 7.

B.3.2 Background Discussion - encapsulation coding

Before diving into the decoding process, it is useful to understand the source of the binary bits encapsulated in this string. AIS is radio technology that broadcasts messages using channels in the marine VHF band. There are a number of messages that can be broadcast by an AIS unit. The bit-by-bit descriptions of the contents of these messages are documented in tables contained in the ITU-R M.1371 international standard for AIS. Table 15 of the ITU-R M.1371-1 recommendations is used in this example. Table 15, ITU-R M.1371-1 identifies all of the information needed to convert the encapsulated binary bits into information. The table identifies the bits, gives them parametric names, and units.

The bits listed in Table 15, ITU-R M.1371-1 are the Message Data portion of a larger packet of binary bits that are created and broadcast by an AIS unit. The sample VDM sentence shown above is an example of the output that would be created by every AIS unit that properly received a single AIS unit's broadcast. The following diagram, Figure B-1, shows the various portions of the "radio packet" that are created and broadcast by an AIS unit. The additional bits that are added to the information bits are needed to facilitate the use of radio signals to broadcast the packet. These additional bits are automatically removed by the receiving AIS units. Only the Message Data bits (those described in the tables - such as Table 15, ITU-R M.1371-1) are encapsulated in the string contained in the VDM sentence. Examples of some of the extra bits that are removed before creating the encapsulation string, are labeled in Figure B-1 as Preamble, Start Flag, and Frame Check Sequence.

Preamble or Training Sequence (24 bits) **Start Flag (8 bits)**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	1	2	3	4	5	6	7	8
0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	1	1	1	1	1	0

Message Data (maximum of 168 bits for a single slot message)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	.....	157	158	159	160	161	162	163	164	165	166	167	168
?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?		?	?	?	?	?	?	?	?	?	?	?	?

Frame Check Sequence (16 bits) **Start Flag (8 bits)**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	1	2	3	4	5	6	7	8
?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	0	1	1	1	1	1	1	0

Figure B-1 - Radio Signal source of encapsulated VDM binary data.

Assume, as an example, that the first 12 bits of the Message Data in Figure B-1 (bits 1 to 12) are: 000001100000. These would be the first 12 bits coded into the VDM encapsulated string.

The VDM sentence encapsulates data using the symbols of the "6-bit" Field Type. Each of the 64 possible combinations of one's and zero's that can make up a 6-bit string has been assigned a unique valid character. These assignments are listed in Table 7 of IEC 61162-1, *6-bit Binary Field Conversion Table,* (see Annex B.4.7).

For example, the first 12 bits would be divided into 6-bit strings, that is: 000001 and 100000. Using Table 7, the binary string 000001 can be represented by a "1", and the binary string 100000 can be represented by a "P". The first two characters in the VDM sentence encapsulated string would then be "1P". Note that observing upper and lower case letters is important when using Table 7.

The maximum number of Message Data bits, that can be contained in an AIS radio message, is 1008 bits. This number of bits requires 168 6-bit symbols. This quantity of characters is too many for a single sentence. Standard sentences cannot contain more than 82 characters, and that limit includes a number of required characters. When coding or decoding the encapsulation string, the string itself may require several sentences to transfer. The VDM sentence structure has been designed to allow an encapsulation string to be broken into smaller strings that are transferred using multiple sentences. The important point to remember is this. Treat the "broken strings" or "reconstructed string" as one continuous string. After all, the complete string contains the continuous "Message Data" portion of an AIS radio packet (see Figure B-1).

Although the string being used in this example can fit in one sentence, it could also be broken and transferred using two sentences. In fact, it need not be broken at any specific point. The two sentence pairs below are equivalent and are proper sentences for the transfer of the same encapsulation string.

```
!AIVDM,2,1,7,1,1P000Oh1IT1svT,0*58<CR><LF>
!AIVDM,2,2,7,1,P2r:43grwb0Eq4,0*7C<CR><LF>

!AIVDM,2,1,9,1,1P000Oh1IT1svTP2r:43,0*7B<CR><LF>
!AIVDM,2,2,9,1,grwb0Eq4,0*5F<CR><LF>
```

Note that the complete encapsulated Message Data string itself does not change in the two pairs, but that the "checksum" for the sentences does change. Using either VDM encapsulation pair, the encapsulated string remains: `1P000Oh1IT1svTP2r:43grwb0Eq4`.

Figure B-1 shows the Message Data as a horizontal table of bits. This can be shown in other ways. The left table in Figure B-2 shows how the Message Data bits can be redrawn in a table with 6 columns and as many rows as are needed to hold all the Message Data bits. The numbers in each of the table positions indicates the Message Data position of the bit in the AIS unit's broadcast. Organizing the bits in this manner allows easy use of the conversion information shown in Table 7.

The following discussion will use "table lookup" methods to describe the decoding process. The reader should also be aware that this standard also contains binary mathematical methods that a computer would use to accomplish the same results.

B.3.3 Decoding the Encapsulated String

The **Background Discussion,** above, described how the AIS unit codes the received binary Message Data bits into the characters of an encapsulation string. It explained that the AIS unit:

- Receives a broadcast message,
- Extracts the Message Data from the radio signal,
- Organises the binary bits of the Message Data into 6-bit strings,
- Converts the 6-bit strings into their representative "valid characters" - see Table 7,
- Assembles the valid characters into an encapsulation string, and
- Transfers the encapsulation string using the VDM sentence formatter.

Again, the sample sentence that will be used in this decoding and interpretation example is:

!AIVDM,1,1,,1,1P000Oh1IT1svTP2r:43grwb0Eq4,0*71<CR><LF>

A calculation shows that the checksum, 71_{HEX}, is correct. This permits the interpretation of the sentence contents to continue. Based upon the definition of a "VDM" sentence (see section B.3.8), this is a "single sentence encapsulation of an AIS VHF data link message." This message was produced by an AIS unit. The binary data, that has be encapsulated, was received on the AIS unit's "AIS1" channel. Also, no bits were added to the binary string when it was encapsulated. The remainder of this example will focus on the proper interpretation of encapsulation string: "1P000Oh1IT1svTP2r:43grwb0Eq4".

The process of decoding and interpreting the contents of the encapsulated string is a three step process:

The string symbols are converted back into the binary strings that they represent.

The binary strings are organised or parsed using the rules contained in the referenced document, in this case ITU-R M.1371-1, Table 15 (also Table 15 in this document).

The referenced document rules are used to convert the binary strings into the relevant information.

B.3.4 Conversion from symbols to binary bits

Figure B-2 is a visual aid that can be used to follow this process for the example string. The table on the left side of Figure G-2, **VDM bit positions**, is provided as a reference that can be used to identify the exact bit position of the corresponding binary bit in the table on the right side, **Bits represented by encapsulation symbol**, of Figure B-2. The use of this "reference grid" will become more clear as the example is discussed.

Down the centre of Figure B-2 is a column into which the example string has been entered from top to bottom. The arrows in Figure B-2 provide an idea about how the logic of the decoding process proceeds. Decoding of the VDM encapsulated string begins with the first symbol in the string. In this case the symbol is "1" and the corresponding binary string from Table 7 is "000001". The binary string is entered in the grid to the right of the "1", as indicated by the arrow. These six bits occupy bit positions 1 to 6. The left most "0" is in position 1 and the right most "1" is in position 6. Note how this corresponds with the reference diagram on the left of Figure B-2.

The second symbol in the string, "P", is processed next. The "P" represents the binary string "100000". This binary string is entered into the next row of the right grid - VDM bit positions 7 to 12. The same process is followed for each of the symbols of the encapsulate string down to the last one, which is a "4". The "4" represents the binary string "000100". This binary string is entered into the "last" row of the right grid - VDM bit positions 163 to 168.

The process of loading up the right grid with binary strings is a mechanical process that has nothing to do with the information content of the encapsulated binary data. It is simply the reverse process from what the AIS unit did to create the encapsulation string during the process of creating the VDM sentence.

B.3.5 Organising the Binary Message Data

The work sheet has been filled in to decode an "AIS Message 1". Notice that the two grids in Figure B-2 have a variety of shaded (colored) blocks. This was done to make it easier to locate the specific bits making up the message 1 parameters in the decoded array of binary bits. The fact is, these blocks could not be filled in until the message type (message number) of AIS message was identified. Identification of the AIS message is done from the first six bits of the binary Message Data. The message number is simply the decimal equivalent of the binary number. In this case, 000001 = message 1. After this is known the remaining blocks of the message can be shaded using information in Table 15, ITU-R M.1371-1.

The parameters listed in Table 15, ITU-R M.1371-1 are transmitted over the radio link as Message Data in the same order that they are listed in the table. The "Number of bits" column of Table 15, ITU-R M.1371-1 used to establish the bits that apply to each of the parameters in the table (refer to Table 15, ITU-R M.1371-1):

1) Message ID, bits 1-6
2) Repeat Indicator, bits 7-8
3) User ID, bits 9-38
4) Navigation status, bits 39-42
5) Rate of turn, bits 43-50
6) SOG, bits 51-60
7) Position accuracy, bit 61
8) Longitude, bits 62-89
9) Latitude, bits 90-116
10) COG, bits 117-128
11) True Heading, bits 129-137
12) UTC second when report generated, bits 138-143
13) Regional Application, bits 144-147
14) Spare, bit 148
15) RAIM Flag, bit 149
16) Communications State, bits 150-168

Once established, this ordering of bits will always be the same for a "message 1". That is, until the reference table itself is changed by a revision action of the ITU.

This same ordering should be done for each of the referenced AIS message tables. For example, if bits 1 through 6 were 010011 after the decoding process was complete, the VDM message identified would be message 19 ($010011_2 = 19_{10}$). This reference is the "Extended Class B Equipment Position Report" message - Tables 32 of ITU-R M.1371-1. The process of organising the decoded binary Message Data requires:

- Identification of the message number, and
- Organising or parsing the binary bits following the appropriate message table.

B.3.6 Interpreting the Decoded Binary Strings

Final conversion of the organised bits into useful information involves the use of the:

- Organised bits - right side of Figure B-2, and
- The parameters descriptive information in Table 15, ITU-R M.1371-1.

For example, the parameter "Repeat Indicator" is two bits - bits 7 and 8. Inspection of Message Data bits 7-8, Figure B-2, shows that its value is "$10"_2$. The descriptive information in Table 15, ITU-R M.1371-1 for "Repeat Indicator" explains that "10" should be interpreted as "repeated twice". This conclusion is recorded in the space to the right of Figure B-2.

The next parameter in Table 15, ITU-R M.1371-1 is the "User ID" (the MMSI number of the unit that broadcast this message). This is a 30 bit binary integer.
The conversion, $1111111_2 = 127_{10}$, discloses this unit's MMSI as 127.

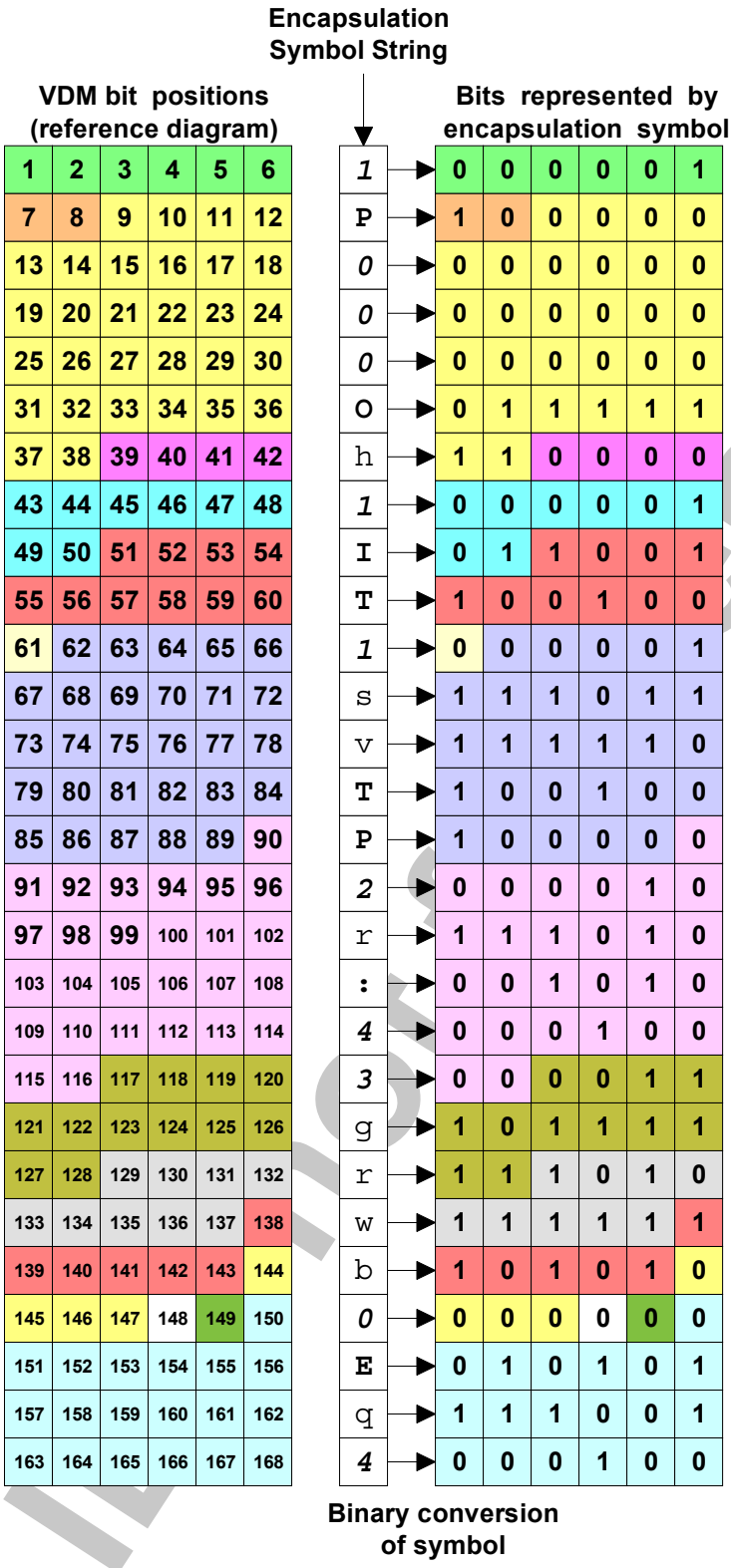
This process continues down Table 15 of ITU-R M.1371-1. The results of each interpretation of the decoded binary Message Data are shown on the worksheet to the right of Figure B-2.

6-bit Binary Field Conversion Table
proposed IEC 61162-1, Table 7

Valid Character	Binary Field	Valid Character	Binary Field
0	000000	P	100000
1	000001	Q	100001
2	000010	R	100010
3	000011	S	100011
4	000100	T	100100
5	000101	U	100101
6	000110	V	100110
7	000111	W	100111
8	001000	'	101000
9	001001	a	101001
:	001010	b	101010
;	001011	c	101011
<	001100	d	101100
=	001101	e	101101
>	001110	f	101110
?	001111	g	101111
@	010000	h	110000
A	010001	i	110001
B	010010	j	110010
C	010011	k	110011
D	010100	l	110100
E	010101	m	110101
F	010110	n	110110
G	010111	o	110111
H	011000	p	111000
I	011001	q	111001
J	011010	r	111010
K	011011	s	111011
L	011100	t	111100
M	011101	u	111101
N	011110	v	111110
O	011111	w	111111

Work sheet for decoding and interpreting encapsulated string:

1P000Oh1IT1svTP2r:43grwb0Eq4



VDM bit positions (reference diagram)						Encapsulation Symbol String	Bits represented by encapsulation symbol					
1	2	3	4	5	6	1	0	0	0	0	0	1
7	8	9	10	11	12	P	1	0	0	0	0	0
13	14	15	16	17	18	0	0	0	0	0	0	0
19	20	21	22	23	24	0	0	0	0	0	0	0
25	26	27	28	29	30	0	0	0	0	0	0	0
31	32	33	34	35	36	O	0	1	1	1	1	1
37	38	39	40	41	42	h	1	1	0	0	0	0
43	44	45	46	47	48	1	0	0	0	0	0	1
49	50	51	52	53	54	I	0	1	1	0	0	1
55	56	57	58	59	60	T	1	0	0	1	0	0
61	62	63	64	65	66	1	0	0	0	0	0	1
67	68	69	70	71	72	s	1	1	1	0	1	1
73	74	75	76	77	78	v	1	1	1	1	1	0
79	80	81	82	83	84	T	1	0	0	1	0	0
85	86	87	88	89	90	P	1	0	0	0	0	0
91	92	93	94	95	96	2	0	0	0	0	1	0
97	98	99	100	101	102	r	1	1	1	0	1	0
103	104	105	106	107	108	:	0	0	1	0	1	0
109	110	111	112	113	114	4	0	0	0	1	0	0
115	116	117	118	119	120	3	0	0	0	0	1	1
121	122	123	124	125	126	g	1	0	1	1	1	1
127	128	129	130	131	132	r	1	1	1	0	1	0
133	134	135	136	137	138	w	1	1	1	1	1	1
139	140	141	142	143	144	b	1	0	1	0	1	0
145	146	147	148	149	150	0	0	0	0	0	0	0
151	152	153	154	155	156	E	0	1	0	1	0	1
157	158	159	160	161	162	q	1	1	1	0	0	1
163	164	165	166	167	168	4	0	0	0	1	0	0

Bits 1-6 = Identifier for this message

000001 = **message 1** (Reference Table 15 of ITU-R M.1371-1 to interpret following bits 7-168.)

Bits 7-8 = Repeat Indicator

2 = **message repeated twice**

Bits 9-38 = MMSI number of broadcasting unit

00000000000000000000001111111 = **127**

Bits 39-42 = Navigational status

0000 = underway using engine

Bits 43-50 = Rate of turn (equation used)

00000101 = +1.1 degrees/minute

Bits 51-60 = Speed over ground

1001100100 = **61.2 knots**

Bit 61 = Position accuracy

0 = **low (greater than 10 meters)**

Bits 62-89 = Longitude in 1/10000 minutes

00001111011111110100100100000 = **27 degrees 5 minutes East**

Bits 90-116 = Latitude in 1/10000 minutes

00000101110100001010000010000 = **5 degrees, 5 minutes North**

Bits 117-128 = Course over ground in 1/10 degrees

001110111111 = **95.9 degrees true**

Bits 129-137 = True Heading

101011111 = **351 degrees true**

Bits 138-143 = UTC second when report generated

110101 = **53 seconds past the minute**

Bits 144-147 = Regional Application

0 = **no regional application**

Bit 148 = Spare

Bit 149 = RAIM Flag

0 = **RAIM not in use**

Bit 150-168 = Communications State

00 = **UTC Direct**

101 = **5 frame remaining until a new slot is selected, UTC hour and minute follow,**

01111001000100 = 01111:0010001 = **15:17 UTC**

B.4 Computer methods to code and decode encapsulated VDL message data.

B.4.1 Introduction

The previous section used the "table-lookup" method to describe the coding and decoding of AIS VHF data-link message data encapsulated in IEC 61162-1 sentences. Table-lookup is an efficient computer method. However, the symbols shown in IEC 61162-1, Table 7 were selected such that mathematical computer methods could also be used to code and decode the encapsulated message data. This section provides the technical background needed to implement mathematical computer methods.

B.4.2 Review of IEC 61162-1 "ASCII characters"

All information transmitted across the 61162-1 (and 61162-2 "high speed") interface is coded as ASCII characters. ASCII characters are commonly understood to be eight bits in length. The IEC 61162-1 designates that the most significant bit of these eight-bit characters shall always be transmitted as zero. The remaining seven bits allow for 128 possible combinations of symbols. Of these, a portion are used to represent printable characters and the remaining represent machine or control "actions."

The symbols that were chosen to represent the sixty-four possible 6-bit binary combinations in IEC 61162-1, Table 7 were taken from the sub-set of printable characters that IEC 61162-1 designates as "valid characters" (see IEC 61162-1, Table 2). Of the "valid character" sub-set, selected characters have been designated by IEC as reserved. As such, they have special "control" meanings within the IEC 61162-1 standard. These reserved characters cannot be used to represent data. The valid characters that were chosen to represent the sixty-four possible 6-bit binary combinations are shown below in Table G-1 along with the ASCII-code for each valid character.

B.4.3 Correspondence between ASCII characters and 6-bit binary fields

The valid characters chosen to represent the sixty-four 6-bit binary combinations are themselves represented by 8-bit binary combinations. These are the combinations that the computer uses to represent the characters that it transmits to the outside world. Table G-1 contains the specific association between the 8-bit "ASCII-coded" characters defined in IEC 61162-1 and the 6-bit binary combinations used to encapsulate AIS message data. This is the fundamental "mathematical" information that is needed to create a computer algorithm that either converts 8-bit ASCII representations to 6-bit binary combinations, or 6-bit binary combinations to 8-bit ASCII representations. The assignment of the valid characters, to represent the 6-bit binary combination, was done in such a way that mathematical algorithms could be created.

For example, the character "E" represents the 6-bit binary field "010101" as shown above in the IEC 61162-1, Table 7. However, the character "E" is represented by the binary ASCII string "01000101" by the computer. There is a mathematical functional relationship between the two binary numbers. The following mathematical computer algorithms can be used to design software that directly converts ASCII binary strings to the 6-bit binary field they represent, or 6-bit binary fields to the ASCII binary strings that represent them.

B.4.4 Method to convert 6-bit binary to ASCII-code

A mathematical function that will convert a 6-bit binary field to the ASCII-code for the valid character used to represent that binary field, is shown in the logic diagram, Figure G-3. This logic diagram represents the processing required to convert the 6-bit binary field into the appropriate ASCII-code. As a example, take the 6-bit binary number 010101. This value is first tested to determine if it is less than the binary number 101000. In this case, it is. The process continues following the "YES" track in Figure G-3. The ASCII-code for 010101 becomes the sum of 010101 + 00110000 = 01000101. A check of Table B-1 will confirm that this is the ASCII-code for {E}.

Table B-1

6-Bit binary Fields represented by Valid IEC 61162-1 ASCII Character Codes

ASCII HEX = binary	Valid Character	Binary Field represented	ASCII HEX = binary	Valid Character	Binary Field represented
30 = 00110000	0	000000	50 = 01010000	P	100000
31 = 00110001	1	000001	51 = 01010001	Q	100001
32 = 00110010	2	000010	52 = 01010010	R	100010
33 = 00110011	3	000011	53 = 01010011	S	100011
34 = 00110100	4	000100	54 = 01010100	T	100100
35 = 00110101	5	000101	55 = 01010101	U	100101
36 = 00110110	6	000110	56 = 01010110	V	100110
37 = 00110111	7	000111	57 = 01010111	W	100111
38 = 00111000	8	001000	60 = 01100000	'	101000
39 = 00111001	9	001001	61 = 01100001	a	101001
3A = 00111010	:	001010	62 = 01100010	b	101010
3B = 00111011	;	001011	63 = 01100011	c	101011
3C = 00111100	<	001100	64 = 01100100	d	101100
3D = 00111101	=	001101	65 = 01100101	e	101101
3E = 00111110	>	001110	66 = 01100110	f	101110
3F = 00111111	?	001111	67 = 01100111	g	101111
40 = 01000000	@	010000	68 = 01101000	h	110000
41 = 01000001	A	010001	69 = 01101001	i	110001
42 = 01000010	B	010010	6A = 01101010	j	110010
43 = 01000011	C	010011	6B = 01101011	k	110011
44 = 01000100	D	010100	6C = 01101100	l	110100
45 = 01000101	E	010101	6D = 01101101	m	110101
46 = 01000110	F	010110	6E = 01101110	n	110110
47 = 01000111	G	010111	6F = 01101111	o	110111
48 = 01001000	H	011000	70 = 01110000	p	111000
49 = 01001001	I	011001	71 = 01110001	q	111001
4A = 01001010	J	011010	72 = 01110010	r	111010
4B = 01001011	K	011011	73 = 01110011	s	111011
4C = 01001100	L	011100	74 = 01110100	t	111100
4D = 01001101	M	011101	75 = 01110101	u	111101
4E = 01001110	N	011110	76 = 01110110	v	111110
4F = 01001111	O	011111	77 = 01110111	w	111111

A similar calculation can be done using a 6-bit binary field that is greater than 101000. For example, calculate the ASCII-code for 111101. This value is greater than the binary number 101000, so, the process follows the "NO" track in Figure B-3. The ASCII-code for 111101 becomes the sum of 111101 + 00111000 = 01110101. A check of Table B-1 will confirm that this is the ASCII-code for {u}.

Finally, a calculation can be done for the test value. That is, what is the ASCII-code for the 6-bit binary field 101000? This value is not less than the binary number 101000, so, the process follows the "NO" track in Figure B-3. The ASCII-code for 101000 becomes the sum of 101000 + 00111000 = 01100000. A check of Table G-1 will confirm that this is the ASCII-code for {'}.

B.4.5 Method to convert ASCII-coded character to 6-bit binary

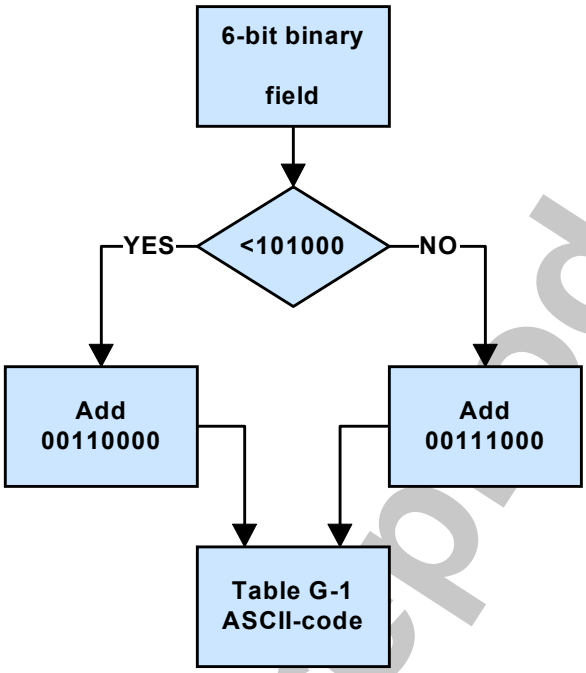


Figure G-3 - Computer process to convert 6-bit binary field to ASCII-code of the symbol representing the 6-bit binary field.

The mathematical process for converting an ASCII-code into the 6-bit binary field is more complex than the 6-bit binary to ASCII-code process described above. The complexity is caused by the fact that the ASCII-code must be tested to ensure that it represents a valid symbol. If the ASCII-code is not valid, the mathematical process should exit through a process that properly terminates the decoding of an encapsulated message. The detection of a single incorrect character in the encapsulation string should end with rejection of the string.

Figure B-4 is the logic diagram representing the ASCII-code to 6-bit binary field conversion process. The initial three tests will detect an error if the ASCII-code (also abbreviated **Code**) is not one of the codes listed in Table B-1. If the ASCII-code does appear in Table B-1, the answer to the first three tests will all be NO, and the value 101000 will be added to the ASCII-code. If the resulting sum of this addition is less than or equal to 10000000, the value 101000 is added to the number. If the resulting sum from the addition is greater than 10000000, the value 100000 is added to the number. After either operation, the six least significant bits (LSB, six right most bits) of the sum are equal to the appropriate binary number.

As an example, consider the ASCII-code 00110000. This code is in Table B-1 and passes the first three decisions. The value 101000 is added to it, and the sum is 01011000. Since this value is less than 10000000, the value 101000 is added to it, and the resulting sum is 10000000. The six LSB are 000000. A check of Table B-1 confirms that this is the correct binary field for the {0} (zero) character.

As a second example, consider the ASCII-code 01110101. This code also passes the first three decisions. The value 101000 is added to it, and the sum is 10011101. Since this value is greater than 10000000, the value 100000 is added to it, and the resulting sum is 10111101. The six LSB are 111101. A check of Table B-1 confirms that this is the correct binary field for the {u} character.

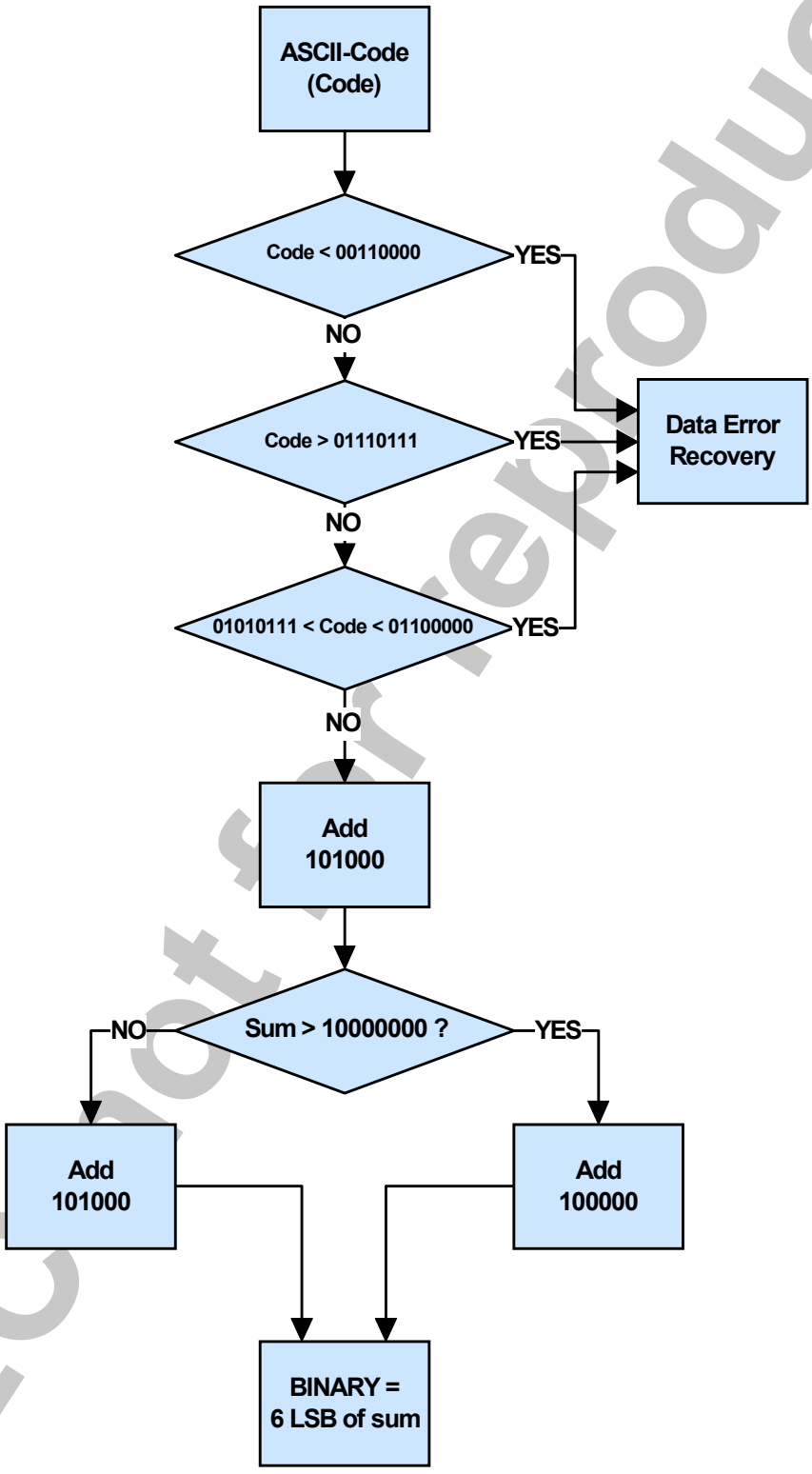


Figure G-4 - Computer process to convert ASCII-code to 6-bit binary field.

Annex C
(Informative)

Long range application

The responsibility of administrations for wide area or offshore monitoring of shipping traffic include safety of navigation, search and rescue (SAR), resource exploration and exploitation and environmental protection in offshore areas including the continental shelf and economic exclusion zones (EEZ). In certain areas the monitoring of tank vessel movements in accordance with any established Tanker Exclusion Zone (TEZ) must be applied. Examples are:

- There is currently a TEZ on the West Coast of Canada.
- There is a mandatory route for larger tankers from North Hinder to the German Bight and vice versa as described in IMO document MSC 67/22/Add 1-Annex 11.
- There are two reporting systems in Australia: AUSREP and REEFREP, both adopted by IMO, which will use the LR application.
- For the long-range (LR) AIS application is chosen for the general principles for ship reporting as described in IMO resolution A.851(20). AUSREP as well as the Canadian application already adopt this method.

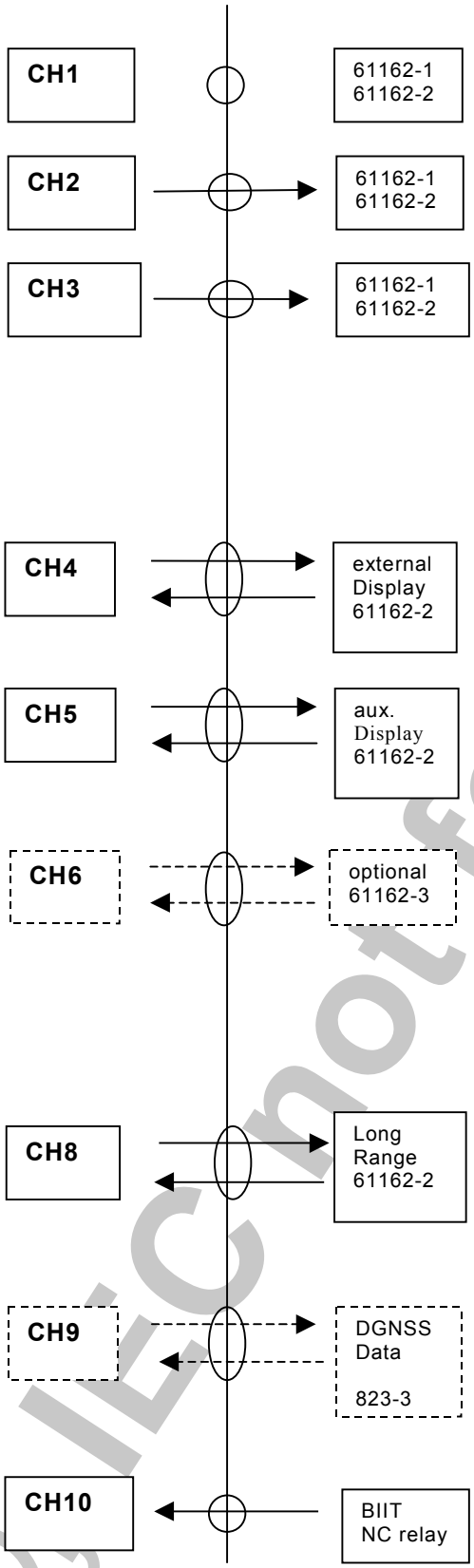
The LR application of AIS must operate in parallel with the VDL. LR operation will not be continuously. The system will not be designed for constructing and maintaining of real time traffic images on a large area. Position updates will be in the order of 2-4 times per hour (maximum). Some applications require an update of just two times a day. It can be stated that LR application forms hardly any workload to the communication system or the transponder and will not interfere with the normal VDL operation.

The LR operational mode will be on interrogation base only for geographical defined areas. Shore base stations shall interrogate AIS systems, initially by geographical area, followed by addressed interrogation. Only standard available AIS information will be replied e.g. position and static and voyage-related data.

The communication system for LR-AIS is not defined in this document. Inmarsat-C, as part of GMDSS on many vessels, can be a candidate to facilitate the LR application, but this will not be mandatory. Most of the current Inmarsat-C, but also all other long-range communication systems, does not support the IEC 61162-2 interface. Because the IEC 61162 series will be standard on all future maritime onboard systems, AIS will be supported by this interface only. This requires for long range application an active interface box to translate the LR AIS 61162-2 messages to the required messages suitable for the chosen communication system and vice versa. This active interface can also gather the information which is not standard available in the AIS. This can be another information system aboard (if installed).

Annex D
(Normative)

AIS Interface Overview



Sensor Inputs

Minimum required input sentences:

Position	GNS, GLL, DTM	int/ext *
SOG	VBW	int/ext *
COG	RMC	int/ext *
Heading	HDT	ext
Rotation Rate	ROT	ext
Route	RTE, WPL	ext
RAIM	GBR	ext

*for priorities see 6.10.3.2

Input / Output of AIS Data

INPUT

manual Data Input:
Voyage VSD
Static SSD
VDL-messages:
ABM
BBM
AIR Interrogation
Other:
ACA channel ass.
ACK Alarm ack.

OUTPUT

VDL-messages:
VDM
(Data block of VDM representing binary Data contents of VDL messages)

Other:
VDO Own ship data
ALR Alarm status
ABK VDL ack.

Long Range Port

Input LRI, LRF

Output LR1,2,3

DGNSS-Data Port

Correction data Information

BIIT Output Port

Annex E
(Informative)

Block diagram of AIS test system